FACTORY MANAGEMENT and MAINTENANCE

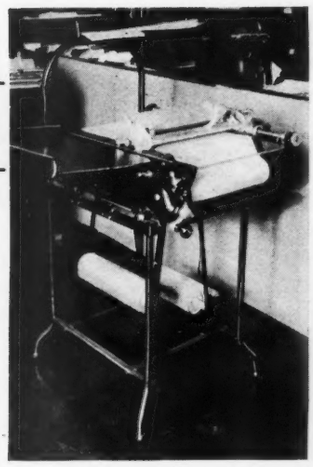
NOVEMBER, 1933

Successful Selling Begins in the Plant

Done by Design

J. S. Hernlund

Chief Engineer
Ditto Incorporated, Chicago



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Figures 1 and 2 illustrate one of the company's biggest sellers—before and after. Utility, appearance, low cost—the things that make goods sell—have been built into it by the factory, not wished into it by the sales organization

IT IS easier to talk about the need for new ideas to help sales than it is to dig them up. Many factory executives who have realized that new ideas and lower costs were the prescription for today's markets have looked for the ideas and found none that was not either taken or not worth taking. But every day one company or another is putting its product and processes to the test and finding unsuspected opportunities for improvement, expensive constructions that can be replaced at lower cost and with better service to the user.

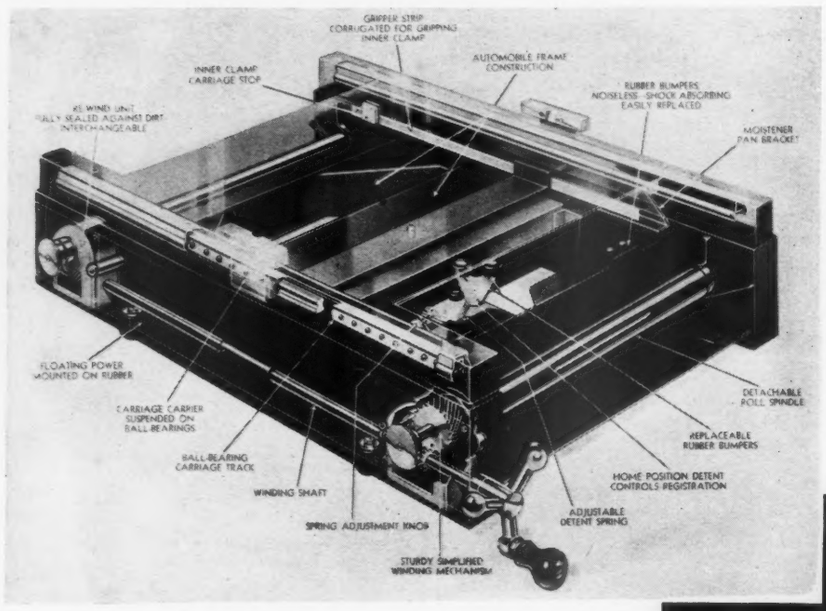
It can be done, for it *is* being done. And, while the details of the changes that result are often of interest only to the company and to its customers who benefit by them, the method by which these firms go about the analysis may offer suggestions to others in totally different industries.

Ditto Incorporated is one of the firms which has successfully redesigned its product to meet the changing needs of today's markets. The company's initial success came because it saw new possibilities in an old product, which doubtless many a manufacturer had looked at and said: "You can't do anything new with a copying pad." The company saw the gelatin-hectograph process not merely as something suited to running off a restaurant menu now and then, but as a flexible and economical means of duplicating all sorts of forms and business documents on a quantity basis. So it multiplied indefinitely the limited capacity of the gelatin pad by spreading the gelatin on a fiber-based roll. It put the rolls in an efficient mechanical duplication machine and went out to show business men how to solve their copying problems with the company's products.

But the company was not content to stop with the success of its product. Styles as well as needs were changing, and the general reduction of sales of the last two years suggested a thorough redesigning of the product as a key to the marketing problem.

One of the company's largest selling models is shown in Figures 1 and 2, before and after. The change obviously improves the appearance and harmony with other modern office equipment, at the same time providing in the dustproof drawers enclosed storage and protection for the gelatin rolls. The disappearing side tray in the new model contributes further to compactness and appearance, and small details of styling may be observed, such as the square lines harmonizing throughout.

Figure 4 is a skeletonized view of the new base. This base supports a bedplate on which the gelatin copying surface lies. The blank sheet to be imprinted is laid down on this copying surface by a carriage (shown


GRIPPER STRIP CORRUGATED FOR GRIPPING INNER CLAMP
INNER CLAMP CARRIAGE STOP
AUTOMOBILE FRAME CONSTRUCTION
RUBBER BUMPERS NOISELESS—SHOCK ABSORBING EASILY REPLACED
MOISTENER PAN BRACKET
FLOATING POWER MOUNTED ON RUBBER
CARRIAGE CARRIER SUSPENDED ON BALL BEARINGS
BALL-BEARING CARRIAGE TRACK
WINDING SHAFT
SPRING ADJUSTMENT KNOB
STURDY SIMPLIFIED WINDING MECHANISM
ADJUSTABLE DETENT SPRING
HOME POSITION DETENT CONTROLS REGISTRATION
REPLACEABLE RUBBER BUMPERS
DETACHABLE ROLL SPINDLE

Figures 3 and 4—the old and the new bases—show in detail some of the changes and economies described in the text. Every day one company or another puts its product and processes to the test, as Ditto did, uncovers unexpected faults, finds ways to remedy them, learns how to apply modern equipment and methods to the task of turning out a superior product at lower cost

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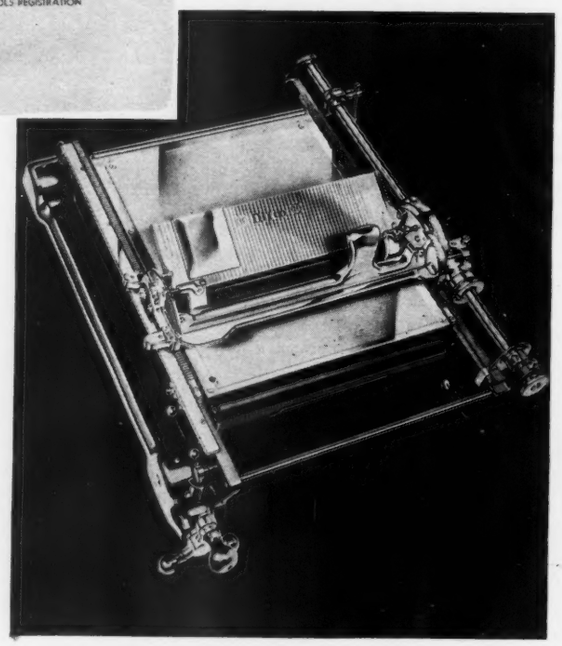


in Figure 3) which moves back and forth across the base, laying the paper down on one stroke and picking it up printed on the return.

These two figures show more in detail some of the changes and economies effected. Figure 3 is a view of the old model. Comparing the two, the first change noticed is the substitution of formed sheet-steel side bars for iron castings. The skeletonized view also shows the new diagonal and cross bracing of sheet steel, which gives increased rigidity to the whole frame and greater support to the bedplate. The use of sheet steel lightened the frame, eliminated the need for a number of machining operations on the castings, provided increased protection for working parts, and simplified and styled the lines of the base.

A comparison of the two views will show another interesting detail of design for economy. In the old machine the sheet to be imprinted was laid down and picked up by a hard rubber roller, which was actuated by gears running in the racks along the sides of the frame. Pressure was supplied by the weight of the carriage; to make this weight effective, the carriage was hinged by running on the heavy circular rod seen at the left side of Figure 3. This rod was made of stainless steel ground to size, and the tolerances had to be very close on it and on the rubber roll, which was built up by hand and machined to size after vulcanizing. Close tolerances and a great deal of expensive machine work were obviously required at many points in the assembly. In spite of care in manufacturing, any neglect in cleaning might result in gumming these fine working parts and clogging them with dust.

These complications were wiped out at one stroke by substituting a cast sponge-rubber roller, which supplied an even more sensitive pressure than the old one. The greater tolerances sufficient with the more elastic material made it possible to simplify the manufacture and maintenance of the machine. It was no longer necessary to hinge the carriage, since the elasticity of the rubber supplied the needed pressure, and the side bearing was done away with. There was a substantial saving in cost, even greater gain in performance.

In place of the side bearing, an idea was borrowed from the construction of filing cabinets. Figure 4 shows two projecting carriers at the right-hand side of the bed. These in turn are welded to a modified I-beam steel section which serves as one track for a pair of ball bearing races. The other tracks are formed by a channel of sheet steel, inverted to protect the bearing from dust and dirt. The new bearing is much freer running, lower in cost, and more serviceable.

Another example of the saving by redesign is shown in Figure 4. The gelatin-surfaced roll, to be used, must be wound across the bedplate and tightened in place. This is accomplished by two pairs of gears, turned by the handle at the lower left. Turned one way, the

handle moves backward and engages the rear gear; reversed, it returns and engages the forward gear, reversing the winding. A ratchet in each gear locks, permitting a slight further revolution to tighten the surface on the bedplate.

In the old machine this mechanism had been housed in the left-hand casting of the bedplate frame. A series of machining operations were required to prepare this casting for assembly. In the new machine it will be noticed that a pair of die-cast cases have been substituted. The whole mechanism is protected by the straight sheet-metal sides of the new model.

The zinc alloy die-castings come ready for assembly without machining. At first the company doubted the economy of making complicated molds for the comparatively small quantities in which the machines are built. Detailed figures showed, and experience confirmed, however, the logic of putting all the tooling and set-up work inevitable with any new part into a carefully made mold which would save all subsequent repetition of this preparatory work.

An even more intricate die-casting job is the new carriage frame, not illustrated except in Figure 1. The substitution here was for a mold casting which required machining at all working points and finishing all over. The die-cast substitute, delivered ready for plating and assembly, costs about the same as the original casting did in the rough.

The old bedplate presented a troublesome manufacturing problem. It supported the moist gelatin copying surface and was etched to produce the embossed surface which prevents forming a vacuum lock with the roll. It was given an elaborate plating, five successive coats of copper, nickel, cadmium, and chrome—in spite of which it was not proof from occasional corrosion after long use. For this plate was substituted one of aluminum, with bosses raised by a controlled embossing operation instead of by etching. The surface of the plate is hardened by a special anodic treatment which gives it a hardness and resistance to oxidation equal to that of chromium plate.

In this extensive overhauling, with so many changes in specifications of parts, one question was whether to go into the manufacture of some or all of these parts or continue the previous policy of limiting the company's manufacturing, so far as machines are concerned, to assembly. It was decided to continue purchasing and assembling. The production of machines is really secondary to the company's manufacturing and sale of forms and supplies adapted to hectographic reproduction. By purchasing, the company has minimized its investment and avoided dissipating its energies in the small-scale production of a great variety of parts.

This description by no means covers all the problems met in overhauling the line. It suffers in that being confined to a single model it conveys an impression of simple and effortless solution which gives little idea of the actual amount of labor and investigation consumed in the development of other models. Yet it serves to indicate that in the general approach back of these thorough-going and successful changes the great problem is always to see where change is possible.

The start toward redesign is nearly always in the application of some test or criterion by which to examine in detail the adequacy of the existing product.

Examine the new and old product from the standpoint of some of these tests. Take "style." If applied with an open mind, it has revolutionized many products.

No sales department can go out and do a really good job of selling until the factory has sifted over every possible way of building into the product the things that make goods sell. That is the factory's responsibility for sales. That is why we say over and over again that "Successful selling begins in the plant"

The style changes were in this case partly the simplifying and harmonizing of the basic lines of the machine, partly the substitution of one construction for another equally serviceable but outmoded.

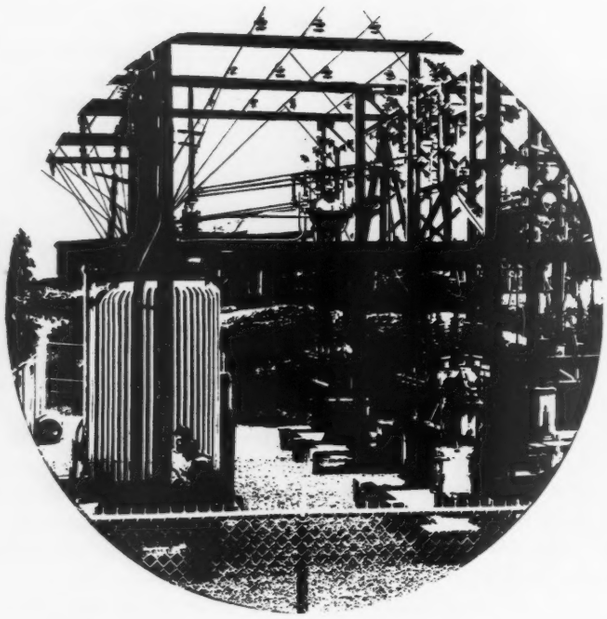
"Convenience" is another test of overlooked possibilities. The Ditto machine had already been studied and restudied from the standpoint of economical use. Nevertheless, from this latest study emerged such modifications as the hinging of the side shelf and the placing of compartments along its front edge for clips and pins. The sockets into which the roll spindles drop were also simplified, to save time in placing the roll.

"Practice in other industries" is a fertile source of suggestion. There is little apparent similarity between an automobile and a Ditto machine, but from the automobile was drawn the idea of "floating power" used in the carriage suspension. Rubber bumpers and a rubber-insulated mounting absorb the shocks incident to operation and prevent their transmission to the cabinet and floor. The diagonally braced carriage also borrows from automobile chassis frame construction.

"Cost" is, of course, an inclusive criterion demanding examination from many angles. Can new materials be used to advantage? New processes or standardized parts? The soft rubber roller, the die-cast alloy parts, the sheet-metal frame and cabinet (put together by spot welding and driven screws), the hardened aluminum bedplate, illustrate savings of this sort.

The changes in this model alone represent manufacturing economies that make it possible for the company to occupy a favorable position in the present-day competitive market as well as to give the user a more attractive and more serviceable product. The approach and methods may point the way to large contributions which the factory can make to the effort of the sales department to meet today's market demands.

Principal Developments in Electrical Distribution



Transformers

Advances of consequence have been confined mostly to the large-capacity transforming equipment used by power companies; practically the only new departure in industrial equipment of this sort is a wider use of transformers with load-ratio control. Three phase, tap changing transformers of this type have been built for the operation of synchronous converters for electrolytic work, with Y-delta starting switches as integral parts.

Air-cooled transformers have been gaining in popularity for service in many locations where a fireproof vault would be required for oil-filled equipment. Practically any low-voltage requirement can be met by the use of air-cooled transformers; many standard makes are available in sizes up to 50-kva. rating.

One such type has been developed to take care of industrial lighting and small power loads. It is air-cooled (without insulating oil) and can therefore be installed inside industrial plants without providing special, fireproof vaults. Its use results in a considerable saving in the cost of a fireproof inclosure, and in allowing transformation from 230- or 460-volt power lines down to 115 or 230 volts for lighting and small power loads to be made at any convenient point in the plant. This arrangement leads to increased efficiency of the system by permitting individual transformers to be cut off when the circuits they feed are not in use, thus saving the losses that would be present in one large oil-filled transformer bank.

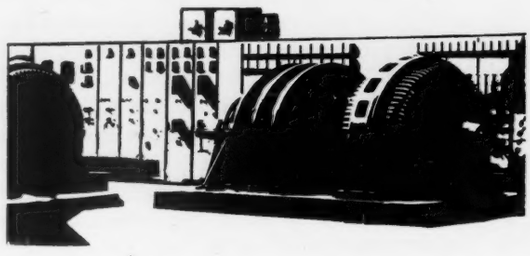
In general, substation equipment is being simplified and standardized to the point where much of it can be obtained assembled by the manufacturer. For example, an outdoor substation unit combining transformer and switchgear in a single, factory-assembled, metal-built unit is available.

Switching Equipment

The tendency toward the use of factory-assembled units, to be built up in sections as needed at the plant, has been more pronounced in switching than in any other industrial equipment. Insulated steel panelboards and housings have practically displaced the old-fashioned marble or slate open construction.

Dead-front distribution centers made their first appearance some years ago. Use of this type of equipment soon became an accepted standard, because of the safety provided, so that today dead-front units are required in some vicinities.

A standardized sectional switchboard is available in the dead-front, totally-inclosed type, consisting of steel panels and frames, in which are incorporated ball-bearing switches. Provision is made for the interchangeable mounting of switches of any desired number of poles, capacity, and voltage. Air circuit breakers, oil breakers, and meters may also be included.



Continuing the series on improvements in important industrial equipment. Previous articles covered Plant Service, Mechanical Power Transmission, and Electrical Control Equipment

Equipment

One result of the availability of sectional panelboard and breaker units has been the design of distribution systems employing a larger number of panelboards, each having a smaller number of branches. Extension of the length of circuit runs is more expensive than the increased cost of a larger number of panelboards. Limitation of the capacity of lighting panelboards to a maximum of 200 amperes has stimulated this development.

A cabinet type of distribution panelboard is now available which, divided up into compartments, segregates the various circuit leads and eliminates the wiring congestion usual in panelboard gutters.

For power and light circuits, the automatic circuit-breaker type of panelboard first came into popularity several years ago, and has been superseding other types. Where use of fuses is desired, a dead-front unit panelboard is available, designed for safe fuse replacement and for convertibility of unit sections.

Circuit Breakers

Perhaps the outstanding development in industrial circuit breakers has been the adaptation of the de-ionization principle of arc extinction to switches of industrial sizes. De-ionization has been applied for some time to high-tension, large-capacity equipment. In the application of this principle, the arc is broken up into many small arcs in series by means of a stack of copper plates, so that as much use as possible is made of the de-ionized space close to each one of a series of cathodes. De-ion breakers are essentially a.c. devices. The d.c. ratings of such breakers are less than one-half of their a.c. voltage ratings for the same current capacity.

The de-ion design used for large industrial breakers has been adapted to the development of small units for low-voltage, low-amperage circuits. Now, the entire electrical distribution system of a plant—the small branch circuits as well as the large main circuits—may be made up without fuses.

Such breakers are also available in individual sections, so that a panelboard of any desired capacity may be built up conveniently.

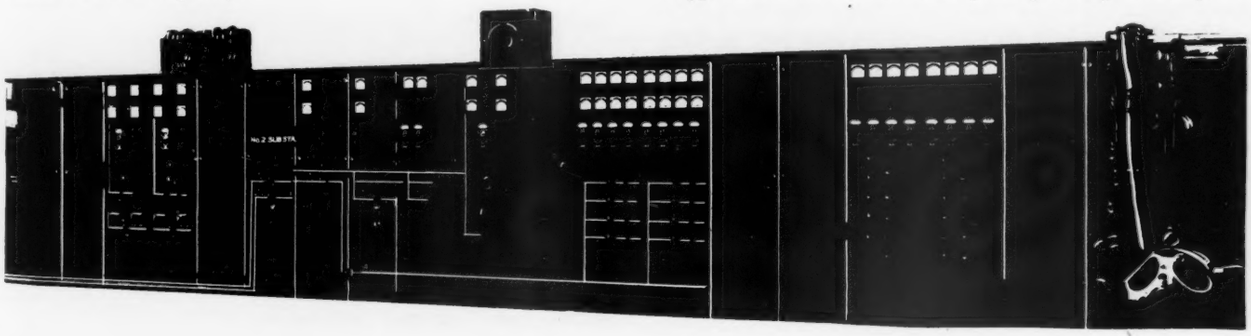
Interesting developments have been made in arc extinction in air circuit breakers. In one industrial-size breaker the arc extinguisher comprises suitably arranged field coils embedded in molded asbestos barriers of the plug-in type, easily removable for access to the contacts. It interrupts the arc without undue voltage disturbance by quickly stretching it beyond its critical length; by the cooling effect of the sudden expansion of the gases at the barrier mouth; and by moving the arc rapidly through the air. Standard sizes are rated 440 and 550 volts.

Industrial circuit breakers employing the magnetic blow-out principle of arc extinction have been developed for service up to 650 volts, 200 to 10,000 amperes, where conditions are severe and operation is frequent.

Improvement in the design of over- and under-voltage and current mechanisms, and in contact tips, has continued. Silver-to-silver and other non-oxidizing, non-welding tips are widely used. Combination of thermal and magnetic trips makes breakers particularly applicable to a.c. motor protection, since they will stay in on starting current but open through the thermal trip on long overload, or through the magnetic trip on short circuit.

Oil circuit breakers have been developed in smaller sizes. Light-duty breakers are now available in a range extending from 50,000-kva. to 2,500,000-kva. interrupting capacity, 5,000 to 50,000 volts. Most of the developments during recent years in this type of equipment have been in the large-capacity breakers.

Application of the oil blast principle to practically all



breakers rating 50,000 kva. and over has been an important development. The manner in which it is applied varies with the make of the breaker. The principle, however, is the same. The arc formed between the contacts, when the breaker opens, forms gases which by their pressure force oil into the arc path, thereby introducing sufficient insulation to prevent re-establishment of the arc after a current zero. This feature is available in breakers of moderate rating (7,500 volts, 50,000 kva.), as well as in large, heavy-duty, high-speed breakers.

Terminators

The past three years have also shown progress in the design of both low- and high-voltage, cable-end sealing devices. Terminators rated up to 2,300 volts are now available for use with lead-covered or braided cables, with or without conduits. Designed for either oil or compound filling, they require minimum installation space for maximum safety and serviceability. For higher voltages, single- and multiple-conductor terminators have interchangeable bushings and parts, making possible easy replacement and low maintenance cost. They are water-, vacuum-, and oil-tight.

Lightning Arresters

The outstanding advance has been the development of a material which has the property of being both a good insulator and a good conductor of electricity, depending on the voltage to which it is subjected. When the voltage is below a certain critical value, the material acts as an insulator; when the voltage rises above this value, the material becomes a comparatively good conductor and allows current to flow freely until the voltage drops below the critical value, after which it again becomes an insulator. Several makes of lightning arresters which make use of a material of this nature are available.

Small arresters rated 4,800 volts or less have been developed for the protection of distribution transformers. The arrestors are suspended inside the transformer tanks, and connected between the incoming high-voltage lead and the grounded lead on the secondary side.

Relays

Benefits of some of the advances made in relays for use on transmission lines have accrued to those used on industrial boards. Over- and under-current and voltage, current-differential, directional, and other types of relays have been subject to improvement in speed, accuracy, and appearance. Mercury contacts in use today have practically indefinite life, because of the absence of burning.

Fuses

Development has continued in high-potential fuses for primary power installations where it would not be economical to provide oil circuit breakers. The usual modern design comprises a glass cylinder containing an arc-extinguishing liquid, such as carbon tetrachloride. In some cases spring action is provided to cause rapid separation of the ends of the fuse after a fault, in order to secure quicker breaking of the arc.

A fuse containing a thick-walled cylinder of solid boric acid is available for interrupting up to 20,000 amp. at 13,200 volts. In the center of this cylinder is a plunger. The fuse wire, serving as one terminal, keeps this plunger from being drawn deep into the cylinder by a spring. When the fuse wire melts the arc is drawn into the hole in the boric acid, causing an outrush of water vapor which extinguishes it at once.

Development in industrial fuse design has not lagged. Fuses provide an inexpensive method of protecting electrical equipment, and improvements in the matter of time-lag and accuracy of rating have increased their usefulness. A former objection to fuses was inability to discriminate between harmless, short-time overloads and more serious faults. This weakness has been remedied in a fuse now available, which has a time lag far in excess of the old type, so that it does not jeopardize continuous operation of the plant, although it protects the equipment. Another source of trouble—overheating because of poor contact—has been overcome in this type. Improvements in fuse clips providing positive pressure reduce heating due to poor contact.

Wiring

Flexible electrical distribution systems are gaining in popularity. They facilitate rearranging of equipment by making it easier to attach motors to the line at any place, and greatly reduce the time and cost of installing new equipment by providing easily accessible outlets.

Several types of flexible installations are available. Heavy outlet plugs may be located at various places in the ceiling over a large factory area, and all equipment connected by means of flexible cable or rubber-covered wire. Distribution troughs for all electric wiring have also been made available. These are thin-gage steel channels of square cross-section, obtainable in sections ranging from 1 to 5 feet in length. The sections have cut-out holes at short intervals along their entire length. When it is desired to attach a motor or machine to the line, it is merely necessary to punch out one of these holes and run conduit, flexible cable, or wire from the machine to the distribution lines, which are laid loosely in the troughs.

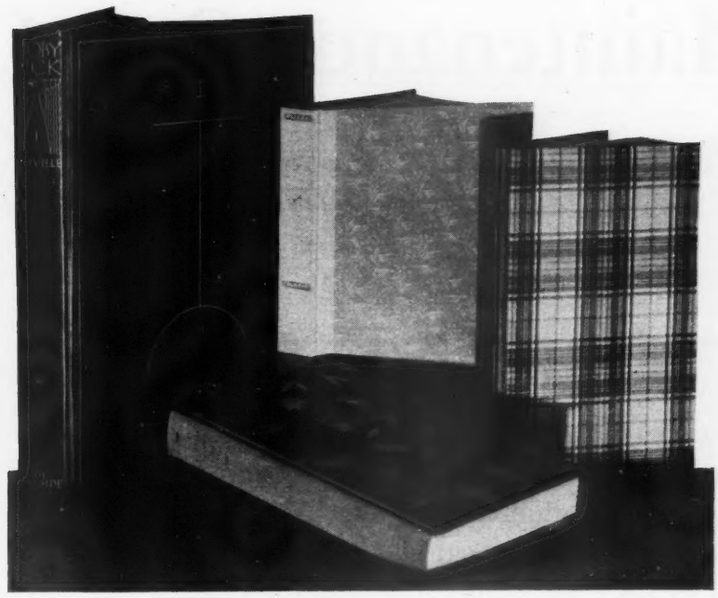
In another system of this sort, the sections of trough or duct contain insulated busbar, and leads to motors or machines are attached to special plugs which may be clamped to these bars at any desired point.

Power Factor Equipment

In many localities poor power factor is penalized in one way or another, so that improvement may result in a considerable saving in power bills. Even where no such penalty is charged, installation of proper corrective equipment is often justified by the resultant improvement.

Small capacitors are available for installing directly at motors; larger units may be used at the point where power lines enter the plant. High-capacity units filled with gas instead of oil have been developed, making possible more compact installations.

Quality Bound



It is a long way from catalogs and directories to fine books in limited editions—but every typesetter, every pressman, every bindery operative who went on this artistic adventure got something out of the trip that is reflected in everyday work

WHAT is the answer to the too-often profitless highly competitive markets of the day? Mere unimaginative cheapness is no answer, for there is always someone who thinks he can sell cheaper still. Cost reduction is important, but there is a limit to its possibilities. Lowering quality standards carries in itself the seeds of destruction.

Facing a condition of price competition which they believe likely to continue for several years, the executives of R. R. Donnelley & Sons Company, Chicago printers, are directing their emphasis to a less crowded field. They believe discriminating customers will appreciate the ultimate cheapness of quality.

Quality in printing is peculiarly a matter of workmanship. A telephone directory looks like, and indeed must be, a cheap job. But every letter, every digit in the hundreds of thousands of listings must be right; every page of millions, perfect. Mail-order catalogs may look cheap, but they require more skill in printing than the gaudiest magazine cover. The colored illustration in the catalog is in effect the sample from which the customer orders. The ink must be kept exactly matched through an edition of millions. There is hardly any job that is not a particular job.

Good workmanship and painstaking attention to quality are not to be installed overnight, nor put on and taken off like a coat. They grow.

The real basis of good workmanship is difficult to put into words. It is not negative. It is not primarily a matter of money. It is an ideal not wholly commercial, although its results have a commercial value. Usually it starts from one or a few men in the organization whose influence spreads.

A gift by the Donnelley family, made to the company at the time the new building was put up, as a practical memorial to the founder of the business, has made it possible to realize a dream long cherished. The general reception lobby on the eighth floor of this building has been enlarged into a small gallery. It houses a succession of carefully selected loan exhibits of fine printing and allied arts.

On either side of this combined reception room and gallery is a hallway, terminating in a library. One of these libraries houses a collection of books and printing executed by the company, the other an assembly of the fine printing of all ages.

Gallery and libraries are open to the public. The company benefits by a form of publicity appreciated by discriminating people. More important than that, the whole organization, from pressman's helper to president, is exposed to continuous education in good taste.

Many of the company's employees have developed artistic interests; there are amateur etchers, painters, collectors galore. Indeed, the company itself has to its credit an adventure primarily artistic rather than commercial in the publication, in distinguished editions and with the cooperation of notable contemporary illustrators, of four American classics. Thoreau's *Walden,* Dana's *Two Years Before the Mast,* Melville's *Moby Dick,* and Poe's *Tales of Mystery and Imagination* were published to call attention to the permanence of the best of our early American literature, and to prove that modern machinery can be made the instrument of as beautiful workmanship as the traditionally regretted tools of a handicraft age. This has so far been the company's sole excursion into publishing, a field it by policy leaves to publishers. That the venture was commercially successful is of interest. But the important fact is that every typesetter, every pressman, every bindery operative who had a hand in the making of those books, learned in a genuine and unforced way to think of his work as something in which there was a goal of artistic perfection to be reached.

Maintenance Cost Control

VI—Control by Time Allowance

W. C. Zinck

Head of Standards, North & Judd Manufacturing Company
New Britain, Conn.

No one has ever before said so much about maintenance cost control in so few words as the author of these six well-documented articles. Concluded here, they give plant executives a quick picture of the best way to set up a maintenance organization on the same scientific basis that obtains in all other phases of manufacturing

CONTROL of maintenance costs by time allowance embodies this principle—for each maintenance job a time allowance is established to cover the actual work to be done, and the worker who does the job is paid according to some ratio of his total elapsed time on the job to the time allowed. This gives a close control over the individual costs. Total expenditures are checked, in addition, to keep them in reasonable proportion to the sales income. With consistently fair time allowances, the performance of the maintenance division is satisfactory when the total elapsed time is equal to, or better than, some definite proportion to the total time allowances.

The theory underlying the time-allowance method, if it can be called a theory, is the observed fact that the average worker will do more work per unit of time under a wage incentive than on straight day work. This reduces the total cost of the job, because in all incentive systems applicable to maintenance the hourly earnings increase at a slower rate than the amount of work that must be done per hour to increase the hourly earnings.

The time-allowance method has as its basis for establishing maintenance standards a thorough and detailed analysis of the entire maintenance duties and work. With the results of the analysis as a guide, an estimator determines the time allowance for any specific job, and the employee is paid according to that allowance and the particular incentive system in force.

The analysis of the maintenance organization and duties must be carefully made, but as it is made but once, care can be taken without an undue total cost of applying and operating the system—and the real value of the system depends upon the background established by the analysis. The analysis will show the place of the maintenance division in the plant organization and the work of the maintenance division as such. It will outline the organization of the maintenance division and group and classify its various duties. The usual grouping is of three kinds, the routine jobs, such as inspection or lubrication, which are listed and scheduled on a weekly and monthly basis; minor (running) repair jobs, such as replacing electric light bulbs or repairing belts; and major repair jobs, replacements, and special work, such as replacing bearings, changing a motor armature, or installing a new machine. The analysis will consider the personnel of the organization, delineate the lines of responsibility, and assign each employee to the type of work he can do best.

When the analysis has considered the organization, duties, and personnel of the maintenance division, and not until then, it will attack the problem of time allowances. It is at this point that the analysis differs for each particular application. If the worker is to be paid on a straight piecework basis, the allowances will involve the same technique of time study that is used in regular productive work to obtain accurate individual costs. If the worker is to be paid on a task and bonus system in which he is paid a percentage of the time saved on the estimated time allowed, it is not so imperative to have accurate allowances. In this case the work necessary involves a survey of past performances, a time-study survey to establish the general constants, and the establishment of a routine to record current performances to make them available for use in estimating future jobs.

Whatever method is employed to determine the time allowances, the analysis in its last step correlates and classifies all time-allowance data, prepares the necessary standard-practice sheets, and teaches an estimator how to

[17] "Departmental Analyses and Wage Incentives," W. G. Uhlir, Consulting Industrial Engineer, Harvey, Ill. Maintenance Engineer, April, 1931 (pages 175-178).

[18] Eastman Kodak Company, Rochester, N. Y

[19] "An Example of Gain-Sharing on Maintenance Construction Work," Ernest F. Thayer, Time-Study Engineer, U. S. Rubber Company, Hanover, Mass., *Maintenance Engineering*, November, 1932 (page 427).

set individual time allowances and to keep the system in smooth operation.[17]

Payment for maintenance work on a wage-incentive system gives the most actual work done per dollar spent. However, the total cost of maintenance should be kept in line with other plant activities, or with the volume of productive work done. To that end, management must place a check on the total expenditure. This check is either a broad ratio to productive labor or a general comparison with past experience, for with individual costs controlled closely it is only of general importance to keep the total in line.

Actual applications of the time-allowance system to control maintenance costs vary, as stated previously, in the form of the wage incentive, which usually reflects the degree of accuracy with which the basic data were established. A camera and film manufacturing company established its rate by time study and pays the worker on his efficiency (point-hour) record for the day. An estimator handles twenty employees.[18]

A steel company has its electrical repair work on a time-allowance system in which the time rates are set by time study or comparison, and the operator paid a bonus of half of the time saved.[19]

A rubber company estimates its construction and repair work and pays the worker a percentage of the time saved. On jobs that can be estimated with reasonable ease, the savings are split equally between the company and the worker. On jobs that are particularly hard to estimate, because of the possibility of unforeseen obstacles, the savings, if any, are split 33⅓ per cent to the worker.

Summary—This survey of the control of maintenance costs indicates clearly that modern management knows that maintenance costs can be controlled, and are not a necessary evil to be endured at whatever expense. The degree of control can be as effective as management wishes, from digging out of past experience a simple ratio to some productive factor to a budgeted total expenditure with closely controlled individual costs by means of time allowances.

The best method for management to install to receive the maximum rate of return for each maintenance dollar spent would appear to be a budgeted total expenditure with estimated time allowances. The establishment of a budget policy and the prediscussion of the maintenance problem in accordance with that policy will keep the entire organization "maintenance-conscious"—to use the hackneyed expression—with direct money savings and the intangible results from close cooperation and smooth operation. The analysis to establish the basic time-allowance data for estimating will tone up the maintenance division and keep it in order, while the estimating of all work gives low actual costs with but a small expenditure for setting the allowances.

With the possibility of the control of maintenance costs from a financial point of view firmly established, is it significant of the inevitable advancement in the technique of scientific management that several companies now combine a SERVICE factor with the financial factor to determine the efficiency of their maintenance divisions? The idea of a service factor immediately suggests its worth for control purposes in a highly mechanized industry. Is it important enough to receive major recognition in a maintenance-control system for any manufacturing industry? In any case, it is worth recognition as an indicator of the total effectiveness of a control system—are the hours of shutdown for repairs increasing or decreasing over a period of years? It would seem that the service factor should be the yardstick with which to measure the preventive portion of the maintenance policy. It is preventive maintenance that helps to assure profits to provide dividends—which is the aim of all manufacturing policies.

▼ ▼ ▼

Brush Maintenance Keeps Trouble Away

S. Ein
Hammond, Ind.

COPPER-GRAPHITE brushes give excellent service on sliprings because of their high current-carrying capacity, slow wear, and low contact drop, but for good results proper maintenance is required.

Normal wear of the brushes on the sliprings distributes copper dust over the tubes and washers insulating the rings from the shaft. If the film of conducting material is allowed to accumulate, a flashover will occur if the voltage between rings becomes high enough, as it may at the instant of starting, when the secondary voltage is at the peak value.

Such a mishap occurred in a Middle-Western steel mill which has several 4,000-hp., 2,200-volt, wound-rotor induction motors driving rolling mills. Their secondary voltage is 1,212 volts between sliprings. It was sufficient to cause a flashover on one motor, at starting, because copper dust had been allowed to collect on the insulators. The surfaces of the rings were blistered and had to be ground; many of the insulators were charred; brush-holders were burned; brush shunts were melted. While repairs were being made the rolling mill had to be shut down.

To prevent a repetition, orders were issued that each time the motor was stopped, about once an eight-hour shift, the copper dust must be blown off with compressed air and the insulators wiped with a cloth. The insulators were painted with a special lacquer to give them a smooth, glossy surface and make wiping easier.

In addition, a $\frac{1}{16}$-in. bevel is put on the edges of the brush faces, by several strokes of a rough file, and renewed weekly. The purpose is to remove the sharp corners in order to stop the chipping of particles from the edges.

These measures have prevented further flashovers.

Costs Kept in Hand by Bonus Plan

For positive control of unit costs, Liquid Carbonic offers the simple solution of a well-conceived bonus plan based on time studies of the good old "garden variety"

W. H. Roehlke
Time Study Engineer, The Liquid Carbonic Company Chicago

OUR BUSINESS involves making a very great variety of equipment—all sorts of soda fountain and carbonating and bottling machinery. Some items are sold in large numbers, but in many cases the quantity sold in any one year is not enough to warrant continuous manufacture. Both our wage payment plan and our method of operating the rate and time-study department are influenced by this characteristic variety of runs.

Production is paid for on the Halsey "50/50" plan; a standard time allowance is set for the job, and the man is paid half of any saving over allowed time, or straight time if he fails to make the allowance. We have gradually abandoned the Gantt bonus plan, which gives a payment more like piece rate, in favor of the Halsey plan because of the control and automatic reduction of unit cost the latter plan gives in case an occasional rate is too high.

Our standard plan for setting a rate is for the rate setter and the machine setter to study the job together and make sure that the proper methods and machines, speeds and feeds are being used. Not less than ten readings, or more on short operations, are then taken and recorded as shown in Figure 1. These readings are then arranged according to frequency. In Column C of Figure 1 there are four occurrences of 0.10 minutes, two of 0.11 minutes, three of 0.12, and one of 0.13. In this case a time of 0.10 would be justified; 0.11 has been selected as a conservative standard.

In reducing the minutes per piece to hours allowed per 100 pieces, we multiply by the factor 1.71. Multiplying by 1.667 would be equivalent to dividing by 60/100. Increasing the 1.667 to 1.71 is approximately equivalent to allowing the man 15 minutes in a 9-hour day for personal and incidental delays. For a selected observed time of 0.11 minutes, the hours allowed per 100 pieces would be 0.11 x 1.71 or 0.19 hours. Bonus is computed on the total of the allowed and actual hours for the week, so that one job cannot be favored at the expense of another. The foreman or department supervisor is paid a bonus proportional to that earned by his men.

On many jobs the same operation elements are repeatedly used in different combinations. On such operations as boring and drilling, we have built up files of standard elementary times. For example, in handling small parts we distinguish three classifications by size of part, and allow respectively 5, 10, and 15 minutes per 1,000 pieces for handling time.

On jobs for which complete elementary times are on file, new time studies would not usually be made; the standard would be built up from the elements. Any time which appeared to be out of line would also be checked with the nearest corresponding recorded time elements.

Where small lots are run, there being a probability that larger runs will be called for later, the rate and instruction cards are marked "Not to exceed——pieces," and the job is retimed if larger lots are run later.

A separate allowance is made on every job for the set-up time, so that differences in size of lot require no day-work allowances or other adjustments.

When a job is timed, the man does it first in his own way, then as requested by the time-study man. If the man is unwilling to do this, the job is not timed. Or, the time-study man will record the man's time, but will use previous standards. For example, in polishing a small valve tip a man might hold 20 in his hand and polish one after another, or he might pick up and polish one piece at a time, resulting in a much slower time. The time-study man would either request the workman to work with a number of pieces in his hand, or would go to the records and check the time with previous similar jobs. Every time-study man is expected to be able to demonstrate any operation he asks the man to perform.

After the rate has been set, an instruction card (Figure 2) is made out in two copies. One is retained in the office, the other is filed in the department and used by the rate setter and foreman in making the set-up and informing the man about the job.

Occasionally we run into peculiar situations in setting standard time, as I suppose nearly everybody does. One operation is polishing a narrow strip of marble which forms part of the base of a soda fountain counter. The operator who was being timed, handled one piece at a time on the revolving grinder which does the polishing. After the rate had been set, the operator rigged up a holder which enabled him to grind a dozen pieces with no more effort and in about the same time that he had used for one. We retimed this job, basing the standard time on capacity use of the machine. Now, when the man has a single piece to put through, he goes to his foreman

SHEET NO.

STUDY STARTED 9.30 A.M. / P.M.

STUDY FINISHED 11.0 A.M. / P.M.

	OPERATIONS	A R	A T	B R	B T	C R	C T	D R	D T	E R	E T	F R	F T	G R	G T	H R	H T	I R	I T	J R	J T	K R	K T	L R	L T	M R	M T	N R	N T	O R	O T	P R	P T
1	Time taken for getting tools & Machine No. 502					.0	.10	.10	.07	.17	.06	.23	.27	.50	.36	.86	.24	1.10	.11														
2	Put rod in guide, take out & put in vise bored.					1.21	.10	1.31	.08	1.39	.07	1.46	.25	1.71	.33	2.04	.25	2.29	.10														
3	Release clutch, run back to find size, take out.					2.39	.11	2.50	.07	2.57	.05	3.62	.25	2.87	.33	3.20	.27	3.47	.09														
4	Tighten chuck, counter, release clutch & run forward.					3.56	.10	3.66	.09	3.75	.05	3.91	.25	4.16	.34	4.44	.27	4.74	.11														
5	Release clutch, run back, take out.					4.85	.17	4.97	.07	5.04	.06	5.10	.25	5.35	.31	5.67	.25	5.95	.14														
6	Take out & put in tube & run forward.					6.09	.11	6.20	.06	6.26	.05	6.31	.27	6.58	.35	6.93	.24	7.17	.13														
7						7.30	.17	7.47	.10	7.57	.05	7.62	.28	7.85	.33	8.18	.27	8.45	.17														
8	Release clutch, run back, take out.					9.57	.13	9.70	.09	9.79	.07	9.86	.30	10.16	.35	10.51	.29	10.80	.17														
9						9.94	.10	10.04	.08	10.12	.05	10.17	.30	10.47	.37	10.84	.25	11.09	.17														
10						11.19	.17	11.36	.09	11.45	.05	11.50	.29	11.79	.34	12.13	.30	12.43	.13														
11						12.51																											
12																																	
TOTAL OCCURENCES		N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T
1	Set up			Set up		4	.10	4	.06	6	.05	3	.25	1	.32	2	.24	1	.09														
2	1 Hr.			Run		2	.11	3	.07	2	.06	2	.27	3	.33	2	.25	1	.10														
3				1.00		3	.12	2	.08	2	.07	2	.28	2	.34	2	.27	2	.11														
4				Hr.		1	.13	3	.09			1	.29	2	.35	1	.25	3	.14														
5								1	.10			2	.30	1	.36	1	.29	2	.13														
6														1	.37	1	.30	1	.14														
7																1	.32																
8																																	
TIME SELECTED				1.00		.11		.08		.05		.28		.34		.27		17		1.00		10.00		32.00									
PERCENTAGE OF TOTAL						60		60		60		70		60		60		70															
RECURRENCE PER UNIT				1/100		1		1		1		1		1		1		1		1/35		1/500		1/400									
TIME Incidental				.001		.011		.008		.005		.028		.034		.027		.012		.004		.004		.008									
TIME ALLOWED				.011		.121		.088		.055		.308		.374		.297		.132		.044		.044		.088									

TOTAL TIME ALLOWED 1.540 MINUTES — SEE OBSERVATION SHEETS

TASK SHEET

Figure 1. Observation sheet, showing method of setting a standard time

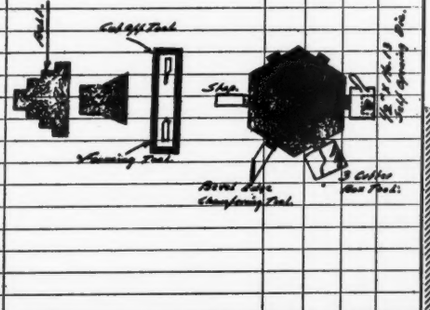
OPERATION Die & Cut off / 1- Chamfer, Box Tool, Form, PART NO. L-2108

PART NAME Shoulder Screw

DEPT 42 MACHINED 519 MATERIAL 3/8 Hex. C.R.S.

HRS ALLOWED PER 100 - 3.40 BONUS PERCENTAGE 50/50 TASK EQUIVALENT PER 9 HR. DAY 26.5

DETAIL OPERATIONS	TOOL	SPEED	FEED	TOTAL MIN. ALLW
Set Up 0.9 Hrs.				
		2nd		



INSTRUCTIONS FOR QUALITY:

This rate not to be used for runs exceeding 25 pieces.

DATE ISSUED BY

WHEN OPERATION CANNOT BE RUN AS SHOWN REPORT TO FOREMAN WHO MUST REMOVE DIFFICULTIES OR REPORT TO RPCL OFFICE.

(OVER FOR SET-UP AND REMARKS)

Figure 2. This instruction card goes to the machine setter. Note use of rubber stamps to make set-up sketches of units frequently used

Figure 3. This card serves as the rate department's record of standard job times. (Back) Representative records of actual times indicate whether the rate is consistent

Date	No. Pcs.	Time Allowed T A.	Time Taken T T	Bonus Pd.	Oper No.	Mach.
1-24-31	500	18.8	1/2 hr.	1933	46	
1-25-	500	18.8	12.2		46	
1-26-	500	18.8	11.8		46	
1-27-	1000	37.6	11.8		46	
1-28-	500	18.8	11.8		46	
1-29-	1000	37.6	23.8		46	
1-30-	500	18.8	23.8		46	
1-31-	1000	37.6	23.1		46	
2-1-	1000	37.6	23.1		46	
2-2-31	1000	37.6	23.1		46	
2-3-	500	18.8	12.0		46	
2-4-	1000	37.6	23.4		46	
2-5-	500	18.8	12.0		46	
2-6-	500	18.8	12.0		46	
2-7-	500	18.8	12.0		46	
2-8-	500	18.8	12.0		46	
2-9-	500	18.8	12.0		46	
2-10-	500	18.8	12.0		46	
2-11-	500	18.8	12.0		46	
2-12-	500	18.8	12.0		46	
2-13-	500	18.8	12.0		46	
2-14-	500	18.8	12.0		46	
2-15-	500	18.8	12.0		46	
2-16-	500	18.8	12.0		46	
2-17-	500	18.8	12.0		46	
2-18-	500	18.8	12.0		46	
2-19-	500	18.8	12.0		46	
2-20-	500	18.8	12.0		46	
2-21-	500	18.8	12.0		46	
2-22-	500	18.8	12.0		46	
2-23-	500	18.8	12.0		46	
2-24-	500	18.8	12.0		46	
2-25-	500	18.8	12.0		46	
2-26-	500	18.8	12.0		46	
2-27-	500	18.8	12.0		46	
2-28-	500	18.8	12.0		46	
3-1-	500	18.8	12.0		46	
3-2-	500	18.8	12.0		46	
3-3-	500	18.8	12.0		46	
3-4-	500	18.8	12.0		46	
3-5-	500	18.8	12.0		46	
3-6-	500	18.8	12.0		46	
3-7-	500	18.8	12.0		46	
3-8-	500	18.8	12.0		46	
3-9-	500	18.8	12.0		46	
3-10-	500	18.8	12.0		46	
3-11-	500	18.8	12.0		46	
3-12-	500	18.8	12.0		46	
3-13-	500	18.8	12.0		46	
3-14-	500	18.8	12.0		46	
3-15-	500	18.8	12.0		46	
3-16-	500	18.8	12.0		46	
3-17-	500	18.8	12.0		46	
3-18-	500	18.8	12.0		46	
3-19-	500	18.8	12.0		46	
3-20-	500	18.8	12.0		46	
3-21-	500	18.8	12.0		46	
3-22-	500	18.8	12.0		46	
3-23-	500	18.8	12.0		46	
3-24-	500	18.8	12.0		46	
3-25-	500	18.8	12.0		46	
3-26-	500	18.8	12.0		46	
3-27-	500	18.8	12.0		46	
3-28-	500	18.8	12.0		46	
3-29-	500	18.8	12.0		46	
3-30-	500	18.8	12.0		46	
3-31-	500	18.8	12.0		46	
4-1-	500	18.8	12.0		46	
4-2-	500	18.8	12.0		46	
4-3-	500	18.8	12.0		46	
4-4-	500	18.8	12.0		46	
4-5-	500	18.8	12.0		46	
4-6-	500	18.8	12.0		46	
4-7-	500	18.8	12.0		46	
4-8-	500	18.8	12.0		46	
4-9-	500	18.8	12.0		46	
4-10-	500	18.8	12.0		46	
4-11-	500	18.8	12.0		46	
4-12-	500	18.8	12.0		46	
4-13-	500	18.8	12.0		46	
4-14-	500	18.8	12.0		46	
4-15-	500	18.8	12.0		46	
4-16-	500	18.8	12.0		46	
4-17-	500	18.8	12.0		46	
4-18-	500	18.8	12.0		46	
4-19-	500	18.8	12.0		46	
4-20-	500	18.8	12.0		46	
4-21-	500	18.8	12.0		46	
4-22-	500	18.8	12.0		46	
4-23-	500	18.8	12.0		46	
4-24-	500	18.8	12.0		46	
4-25-	500	18.8	12.0		46	
4-26-	500	18.8	12.0		46	
4-27-	500	18.8	12.0		46	
4-28-	500	18.8	12.0		46	
4-29-	500	18.8	12.0		46	
4-30-	500	18.8	12.0		46	
5-1-	500	18.8	12.0		46	
5-2-	500	18.8	12.0		46	
5-3-	500	18.8	12.0		46	
5-4-	500	18.8	12.0		46	
5-5-	500	18.8	12.0		46	
5-6-	500	18.8	12.0		46	
5-7-	500	18.8	12.0		46	
5-8-	500	18.8	12.0		46	
5-9-	500	18.8	12.0		46	
5-10-	500	18.8	12.0		46	
5-11-	500	18.8	12.0		46	
5-12-	500	18.8	12.0		46	
5-13-	500	18.8	12.0		46	
5-14-	500	18.8	12.0		46	
5-15-	500	18.8	12.0		46	
5-16-	500	18.8	12.0		46	
5-17-	500	18.8	12.0		46	
5-18-	500	18.8	12.0		46	
5-19-	500	18.8	12.0		46	
5-20-	500	18.8	12.0		46	
5-21-	500	18.8	12.0		46	
5-22-	500	18.8	12.0		46	
5-23-	500	18.8	12.0		46	
5-24-	500	18.8	12.0		46	
5-25-	500	18.8	12.0		46	
5-26-	500	18.8	12.0		46	
5-27-	500	18.8	12.0		46	
5-28-	500	18.8	12.0		46	
5-29-	500	18.8	12.0		46	
5-30-	500	18.8	12.0		46	
5-31-	500	18.8	12.0		46	
6-1-	500	18.8	12.0		46	
6-2-	500	18.8	12.0		46	
6-3-	500	18.8	12.0		46	
6-4-	500	18.8	12.0		46	
6-5-	500	18.8	12.0		46	
6-6-	500	18.8	12.0		46	
6-7-	500	18.8	12.0		46	
6-8-	500	18.8	12.0		46	
6-9-	500	18.8	12.0		46	
6-10-	500	18.8	12.0		46	
6-11-	500	18.8	12.0		46	
6-12-	500	18.8	12.0		46	
6-13-	500	18.8	12.0		46	
6-14-	500	18.8	12.0		46	
6-15-	500	18.8	12.0		46	
6-16-	500	18.8	12.0		46	
6-17-	500	18.8	12.0		46	
6-18-	500	18.8	12.0		46	
6-19-	500	18.8	12.0		46	
6-20-	500	18.8	12.0		46	
6-21-	500	18.8	12.0		46	
6-22-	500	18.8	12.0		46	
6-23-	500	18.8	12.0		46	
6-24-	500	18.8	12.0		46	
6-25-	500	18.8	12.0		46	
6-26-	500	18.8	12.0		46	
6-27-	500	18.8	12.0		46	
6-28-	500	18.8	12.0		46	
6-29-	500	18.8	12.0		46	
6-30-	500	18.8	12.0		46	
7-1-	500	18.8	12.0		46	
7-2-	500	18.8	12.0		46	
7-3-	500	18.8	12.0		46	
7-4-	500	18.8	12.0		46	
7-5-	500	18.8	12.0		46	
7-6-	500	18.8	12.0		46	
7-7-	500	18.8	12.0		46	
7-8-	500	18.8	12.0		46	
7-9-	500	18.8	12.0		46	
7-10-	500	18.8	12.0		46	
7-11-	500	18.8	12.0		46	
7-12-	500	18.8	12.0		46	
7-13-	500	18.8	12.0		46	
7-14-	500	18.8	12.0		46	
7-15-	500	18.8	12.0		46	
7-16-	500	18.8	12.0		46	
7-17-	500	18.8	12.0		46	
7-18-	500	18.8	12.0		46	
7-19-	500	18.8	12.0		46	
7-20-	500	18.8	12.0		46	
7-21-	500	18.8	12.0		46	
7-22-	500	18.8	12.0		46	
7-23-	500	18.8	12.0		46	
7-24-	500	18.8	12.0		46	
7-25-	500	18.8	12.0		46	
7-26-	500	18.8	12.0		46	
7-27-	500	18.8	12.0		46	
7-28-	500	18.8	12.0		46	
7-29-	500	18.8	12.0		46	
7-30-	500	18.8	12.0		46	
7-31-	500	18.8	12.0		46	
8-1-	500	18.8	12.0		46	
8-2-	500	18.8	12.0		46	
8-3-	500	18.8	12.0		46	
8-4-	500	18.8	12.0		46	
8-5-	500	18.8	12.0		46	
8-6-	500	18.8	12.0		46	
8-7-	500	18.8	12.0		46	
8-8-	500	18.8	12.0		46	
8-9-	500	18.8	12.0		46	
8-10-	500	18.8	12.0		46	
8-11-	500	18.8	12.0		46	
8-12-	500	18.8	12.0		46	
8-13-	500	18.8	12.0		46	
8-14-	500	18.8	12.0		46	
8-15-	500	18.8	12.0		46	
8-16-	500	18.8	12.0		46	
8-17-	500	18.8	12.0		46	
8-18-	500	18.8	12.0		46	
8-19-	500	18.8	12.0		46	
8-20-	500	18.8	12.0		46	
8-21-	500	18.8	12.0		46	
8-22-	500	18.8	12.0		46	
8-23-	500	18.8	12.0		46	
8-24-	500	18.8	12.0		46	
8-25-	500	18.8	12.0		46	
8-26-	500	18.8	12.0		46	
8-27-	500	18.8	12.0		46	
8-28-	500	18.8	12.0		46	
8-29-	500	18.8	12.0		46	
8-30-	500	18.8	12.0		46	
8-31-	500	18.8	12.0		46	
9-1-	500	18.8	12.0		46	
9-2-	500	18.8	12.0		46	
9-3-	500	18.8	12.0		46	
9-4-	500	18.8	12.0		46	
9-5-	500	18.8	12.0		46	
9-6-	500	18.8	12.0		46	
9-7-	500	18.8	12.0		46	
9-8-	500	18.8	12.0		46	
9-9-	500	18.8	12.0		46	
9-10-	500	18.8	12.0		46	
9-11-	500	18.8	12.0		46	
9-12-	500	18.8	12.0		46	
9-13-	500	18.8	12.0		46	
9-14-	500	18.8	12.0		46	
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9-16-	500	18.8	12.0		46	
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9-18-	500	18.8	12.0		46	
9-19-	500	18.8	12.0		46	
9-20-	500	18.8	12.0		46	
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9-22-	500	18.8	12.0		46	
9-23-	500	18.8	12.0		46	
9-24-	500	18.8	12.0		46	
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9-29-	500	18.8	12.0		46	
9-30-	500	18.8	12.0		46	
10-1-	500	18.8	12.0		46	
10-2-	500	18.8	12.0		46	
10-3-	500	18.8	12.0		46	
10-4-	500	18.8	12.0		46	
10-5-	500	18.8	12.0		46	
10-6-	500	18.8	12.0		46	
10-7-	500	18.8	12.0		46	
10-8-	500	18.8	12.0		46	
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10-10-	500	18.8	12.0		46	
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11-1-	500	18.8	12.0		46	
11-2-	500	18.8	12.0		46	
11-3-	500	18.8	12.0		46	
11-4-	500	18.8	12.0		46	
11-5-	500	18.8	12.0		46	
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12-1-	500	18.8	12.0		46	
12-2-	500	18.8	12.0		46	
12-3-	500	18.8	12.0		46	
12-4-	500	18.8	12.0		46	
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12-27-	500	18.8	12.0		46	
12-28-	500	18.8	12.0		46	
12-29-	500	18.8	12.0		46	
12-30-	500	18.8	12.0		46	
12-31-	500	18.8	12.0		46	

PART NAME Pump Packing Nut & Gland OPER. NO 1- Center PART NO. 174-124-X

DEPT 42 DRAWING HRS. ALLOWED PER 100 - 2.65

OPER NAME Center, Chamfer, Drill, Box Tool, & Cut Off — TOTAL TIME UNDER OBSERVATION 1½ Hrs.

PRODUCTION PER DAY DURING OBSERVATION 432

TASK PER DAY OF 9 HRS. IS EQUIVALENT TO QUANTITY OF 340

PERCENTAGE TASK TO OLD PRODUCTION 1668

PERCENTAGE NEW AVERAGE PRODUCTION TO TASK

RECOMMENDED HOURLY RATE 60¢ BONUS PERCENTAGE 50/50

PRODUCTION PER	OLD AVERAGE		IMPROVED CONDITIONS		TASK AND BONUS		NEW AVERAGE	
DAY IN 9 Hrs.	DAY 205	UNIT	DAY	UNIT	DAY 340	UNIT	DAY	UNIT
Set Up 1.0 Hrs.								
DIRECT WAGES								
MACHINE EXPENSE LABOR								
MATERIAL COST								
TOTAL COST								

REMARKS

BLACK ENTRY INDICATES MADE BONUS

RED ENTRY INDICATES LOST BONUS

DATE 2-24-31 SIGNED

Form 0078— Bonus Record Card No 1—H.P.

SUBJECT - RED DIAMOND FILLER

..... we herewith submit a few suggestions and changes, some of which I understand have already been taken care of, but which we deem necessary before an accurate rate can be set on the above in Dept. No. 52 and which will involve very little expense, but will reduce the time considerably:

Redrill holes in velve spider. To be done in Dept. 45. Holes are out of line, jig is being checked so that holes will be drilled in proper place.

Oil hole for 1/2-in. pipe in gear box out of line with base. Hole in base will be cored out in foundry large enough to eliminate re-drilling.

Removing rust on tank supporting sleeve by hand before painting, will now be done in foundry by sandblasting casting.

Get another air hose in Dept. 52 with nozzle on same to do away with all connecting and disconnecting of hose, insert washers, etc. requiring 2 men to take care of same.

Not enough tools on hand such as reamers, drills, etc. Every time man wants a tool he has to borrow same from man on final assembly or wait until supervisor returns.

Drilling 5/4-in. conduit hole in Dept. 52 by hand. This can be done in Dept. 45 with jig.

From the time-study department's report on a job that was retimed when the rate was found to be too high. Only six out of seventeen suggestions for improvement are given here—enough to prove that retiming can be more than an excuse to cut rates

and says: "I don't want to run the machine for just one piece. Haven't you got some other job I can run through with it?" The man has a real incentive to use his time to advantage. Incidentally, this sort of situation seldom arises because every effort is made at the start to set each job up right. This specific case is therefore set down here merely to show how such an unusual situation was handled.

Generally, when a man by his own ingenuity improves the process and shortens the time, we retime the job on a basis which gives him a share in the saving made. We do not retime jobs or change the standard time after the rate is once given the man, except when the operation is changed, but we do keep a check on how the men are making out, on all rates. On the back of the rate card (Figure 3) we enter the allowed and actual time, number made and man's number, on jobs put through under each rate. With jobs done only occasionally, all lots are thus recorded; with those in work many times a year, we enter several random lots a month, enough to give a fair sample. We also file by job number all the time cards on which standard has not been met.

At intervals of about six months, the chief rate setter goes through the cards and studies them, checking and destroying the filed no-bonus time cards at the same time. Usually several men may have worked at a given operation during the year. Most of them will make out, perhaps one or two will not. Knowing the man and seeing his record from the cards in this way, we can judge whether or not the fact that a rate was not made is an indication that it is too close. On the rate card, all jobs failing to make standard time are entered in red. If there are too many red entries in the course of a year, the job is retimed and the standard time allowance increased if necessary. Sometimes a job may have been running all right for two or three years, and then may begin suddenly to show red entries. Usually investigation will show that the part, tools, or job has been changed, and the foreman has failed to request a retiming.

Bonus earnings are also recorded for each man, and give a good measure of his relative value.

With our time standards and the Halsey 50/50 plan of payment, the bonus over hour pay averages 12 per cent. A good man can make 20 per cent or better; a man below average may make from 2 to 7 per cent. If a man consistently fails to make bonus, it is cause for investigation, either of the conditions or of the man.

It is difficult to estimate the savings that have resulted from the use of time study and bonus, but some slight idea of their extent may be had from a single example. On a particular job the past average production as shown by time tickets had been 720 per day. Under time-study observation the output was at the rate of 1,436 per day. The time-study man, selecting the typical times as described, and judging the operator to be a conscientious man who was letting himself out to make a showing, set the task at 1,070, a standard which has been easily maintained by the men, with some leeway to make bonus. In this case, production was increased 50 per cent at standard time, with no increase in cost, while further increases meant not only a bonus for the man, but a further reduction in unit cost.

Many tasks ordinarily considered difficult to time work well on Halsey. Our polishing and buffing, also our marble operations after cutting into slabs, are 100 per cent on bonus. Packing is all on bonus. All assembly, including showroom assembly and disassembly of jobs taken in exchange from customers, is on bonus. We expect ultimately to put assembly on the customer's premises on bonus, allowing separately for traveling time as figured by the traffic department.

To be frank, the element of judgment enters largely into such time study. With one exception our time-study men are not college graduates; they are all men who have come from the shop and been trained in our methods. Possibly a more elaborate application of motion analysis might effect further economies.

While I hesitate to apply the term "scientific" to studies taken in this way, by the comparison of unit times, and particularly by the development of a trained judgment on the part of the time-study man, we do find it possible to secure consistent results and to make substantial savings by the use of this ordinary or "garden" variety of time study.

We do all our timing in the open, and on a basis which permits us to retain the friendship and respect of the men. Our department has consistently shown a profit over its cost, even with reduced operations. With full time and night work, such as we are experiencing now, this profit will become large.

18 Proofs That Instruments Save Money

G. A. Van Brunt
Associate Editor

►► **Maximum efficiency in most manufacturing processes depends to a larger extent than is sometimes realized on the measurement and control of such quantities or factors as temperature, pressure, and the flow of liquids, gases, or electricity. Accuracy of the measurement or control necessary varies rather widely. In many cases close control of one or more quantities is essential in turning out a satisfactory product; in others rough approximations may suffice. Nevertheless, the use of more heat, water, or steam than is required by the process simply means avoidable waste of something that costs money—and, therefore, increased cost of production** ◄◄

1 Savings estimated at $13,000 a year were brought about in a Southern pulp and paper mill by the use of recording thermometers and pressure gages. Closer control of the processes has led to improvement in quality of product and reduction in fuel consumption. The largest saving was made in the extractor plant, in which tannic acid is leached from wood chips. Close temperature control of this process has increased the yield of liquor, with better preparation of the chips.

2 Use of excessive quantities of steam and air by various departments of a plant manufacturing agricultural machinery led to the installation of recording flow meters on the steam and air lines, so that the departments could be billed for the amounts consumed. Result, an immediate saving of about $8,000 annually.

3 Coal-handling equipment in the plant of a Middle-Western chemical plant required a crew of four or five men. As a check on the efficiency, two recording wattmeters were put in the circuit of the motors driving the equipment. The charts disclosed that the motors were operated only a small part of the time, and led to the discovery that the coal was being handled in a costly, slipshod manner. Changes in the methods employed provided a saving of more than $2,400 a year.

4 Excessive quantities of acid discharged into a river by a Southern chemical plant killed the fish and damaged hydraulic equipment belonging to another company. To avoid further trouble, a chemist and sample boy were detailed to analyze hourly samples of the waste water. Use of a recording ohmmeter to make a continuous record of the conductivity of the water, from which the acid content can be estimated, made it possible to release the two men for other work.

5 A saving of more than $650 a year in the cost of steam alone was realized by an Eastern chemical plant through the installation of an automatic temperature control for one unit of equipment.

6 An Eastern manufacturer of non-ferrous alloys installed a meter which records the steam flow, draft, and flue gas and steam temperatures. Changes in practice indicated by study of these records have resulted in a saving of $260 a month, or more than $3,100 a year. The meter pays for itself every few months.

7 A Western manufacturer of stoves made an annual saving of more than $2,600 in the cost of fuel oil for heating an enamel-burning furnace by installing a recording pyrometer and automatic control on the oil feed lines. Control of temperature by hand had proved to be costly and inefficient. An incidental advantage gained is the ability to handle more pieces per heat, due to the maintenance of a more nearly uniform temperature in all parts of the furnace.

8 The plant of an Eastern printing company is heated by steam purchased from a central power station. Difficulty in maintaining uniform temperature in the workrooms, with overheating as the usual result, led to the installation of an automatic temperature control system. Saving in the cost of steam for heating amounts to about 70 per cent. Better working conditions have led to an increase in production.

9 Installation of four automatic hot-blast regulators for the blast furnaces in a steel mill resulted in better operation, improvement in the uniformity of the iron, and a saving of $750 a month.

10 In a Southern plant that produces a building material composed essentially of wood fiber, unusually close control of time and pressure is required in an important operation, to prevent waste of high-pressure steam and insure uniformity of the product. Electrically driven pressure recorders were connected to

the machines involved in this operation. Study of the charts made it possible to improve the machines, make a material saving in the amount of high-pressure steam used, and increase production 20 per cent.

11 Cutting a recording wattmeter into the circuit of a 50-hp. motor driving a lineshaft in a leather tanning and finishing plant showed that the motor was running idle 43 per cent of the time and could be shut down. Prevailing practice had been to operate four machines at a time for a short period. Meter charts proved that the motor could operate eight machines at once, with a further reduction in the necessary running time of the motor.

12 Following the installation of a meter for recording steam and air flow, flue gas temperature, and furnace draft, in the boiler plant of a Southern paper mill, the average evaporation per pound of coal rose from about 8.9 to 9.6. The savings in fuel amount to $24,000 yearly, at which rate the metering equipment pays for itself every 46 days.

13 In the open-hearth furnaces in steel mills, the fuel is introduced first from one side and then from the other, in order to maintain the temperature as nearly uniform as possible throughout the furnace. An automatic reversing control installed by one large steel mill cut the operating costs by more than $1,200 a year.

14 Accurate records taken in the plant of an Eastern carpet manufacturer showed an increase of nearly 9.7 per cent in steam production per gallon of fuel oil, following the installation of a CO_2 recorder. This increase in efficiency represents a saving of $1,200 annually—a return of 358 per cent on the investment.

15 In a Middle-Western plant manufacturing enameled wire, rejections due to improper annealing or baking of the coating ran about 7 per cent of the output. Installation of automatic temperature controllers on the annealing furnaces and baking ovens reduced rejections to 2 per cent. Savings amount to about $3,300 a year—a return of 76 per cent on the investment.

16 An Eastern manufacturer of oilcloth found that a noticeable improvement in the uniformity of the product followed the installation of temperature controllers in the drying ovens. To this intangible but important factor, there is added a saving estimated at $1,500 a year.

17 Savings in fuel amounting to about $2,300 a year were made possible by the use of recording pyrometers in a Middle-Western plant manufacturing glazed tile. There are five glazing kilns, each of which is equipped with a thermo-couple connected to instruments located in the foreman's office, so that he can determine at a glance whether the kilns are being properly fired. Savings due to reduced spoilage are important, but are not included in the figure given.

18 Four boilers in a Middle-Western soap factory were sometimes unable to meet the demand for steam, and it was thought that an additional boiler was required. While this addition was being considered, steam flow meters were installed. From the information which they provided it was possible to make changes in the firing methods and elsewhere which increased the output of steam so much that the existing plant was able to carry the load. The saving in the cost alone of a new boiler was several thousand dollars.

►► For the guidance of industry in cutting production costs, increasing productivity of machines or processes, improving quality or uniformity of product, or reducing spoilage, meters and instruments are available in wide variety. With their aid practically any quantity or factor of importance in plant operations can be measured or controlled.

Indicating instruments show by means of a pointer or otherwise the magnitude at the moment of reading of the quantity with which they are concerned. Familiar examples are the ordinary thermometer and the indicating ammeter.

Recording instruments give a permanent record, usually traced in ink on a moving chart, of the value of the quantity being measured. The value at any instant can usually be determined also, but recording instruments are commonly employed to show what the values were at some previous time, and what the variations were. Recording thermometers and wattmeters come in this class.

The function of a control instrument is to maintain some quantity at the given value for which the instrument is set, by actuating a switch, valve, or other control medium either directly or through a relay. Controllers may indicate the value of the quantity at any instant, or they may include the function of a recorder and give a permanent record. Many controllers merely cause a valve or switch, say, to open or close, and do not give a visible indication or record of the value of the quantity being controlled. In this group are included some temperature and pressure controllers. ◄◄

Production Control

9. *The Foreman's Duties*

Thomas M. Landy

Manufacturing General Department
General Electric Company

Figure 1

IT IS sometimes difficult to convince the foreman that modern production planning and control will help him. His opposition is usually based on a supposed loss of prerogatives. It is true that he does lose prerogatives, but only those he should have lost long ago—duties, in fact, which he should never have had to perform. It has been common experience that the foreman is the greatest booster for scientific management once he sees what it will do for him, but it may take time and patience to show him.

One of the most important advantages of production planning and control is that it frees the foreman of almost all clerical detail and makes it possible for him to do a better mechanical and administrative job. It gives him time to cooperate with the planners in routing the work and specifying tools, and to consult and be consulted on all changes in planning. With the installation of production planning some foremen feel that they may wash their hands of the whole affair. Others feel hurt, think they have been left outside the picture. They have not. It is the foreman who lays out his department, and he it is who says what he wants processed at every work station. Only the details are delegated to someone else. Hence, if there is anything wrong with the planning, the foreman should feel that it is his sole responsibility to correct it.

A foreman must not order an operator to begin work without a time voucher. Likewise, no foreman should order work to be moved. Anything supposedly lying dead should be reported immediately to the dispatcher.

It should also be the foreman's first duty to check the operator's voucher against the identification tag or sticker, to see that both correspond as to drawing number and part, shop order, quantity, and pattern letter.

If the foreman discovers that a job can be run to better advantage when the job is once in operation on a current order, it is not advisable to change the planning on the work in process, but he should immediately see that the master planning card is changed by sending through to the planning office a "Recommendation to Change Operation Record."

Whenever waiting time or down time is necessary, the foreman will fill out a "Request for Waiting Time," sign it, and send the operator to the production dispatch station. When an operator is on waiting time or down time, the foreman must correct the trouble and get the operator back on production time.

Where an inspector's report is secured to cover defective workmanship or material, which it is possible to correct, the foreman should write out the operations necessary on the back of the inspector's report, sign it, and attach it to the dispatch order, which will be found in the foreman's hold-up file on the dispatcher's desk. If the bad workmanship is the fault of the operator, the foreman should make out a "Spoilage Deduction Voucher" and attach it to the dispatch order.

For all other cases of extra cost under three dollars, an "Extra Cost Report" is made out.

The four forms mentioned in the foregoing paragraphs are shown in Figure 1, and from them it will be seen that the only clerical work left to the foreman is in connection with waiting or down time, defective work, and planning. This has been done purposely; no one but the foreman should be able to authorize a man to

go on waiting or down time, since it is all going to revert against the foreman's record, perhaps affecting his bonus.

Defective work, likewise, must remain the burden of the foreman, since he and the operator are solely responsible. It should be obvious that he must have a voice in the planning, since it is he who is being held responsible for his department and its economical operation.

With this added freedom from clerical work, the foreman is better able to suggest more economical ways of doing the work. Experience has shown that with the installation of production planning and control scrap losses go down. It is natural that they should, because the foreman has more time to supervise his operators.

It is not the foreman's duty to make promises. His fundamental job is to meet due dates. He should see that tools are repaired and carried to his tool crib. It is very much his duty to use overtime where and when the dispatcher shall designate.

For the benefit of the dispatcher, the foreman should make a report to his respective dispatch station at least once a day as to: (1) Idle machines (reasons other than 3 and 4); (2) absent workmen; (3) machines with no operator; (4) workmen with no work.

One of the major functions of production planning and control is the proper synchronization of starting and finishing dates of the various parts which go to make up the final product. Because of the highly competitive nature of business, the old method, whereby the manufacturing departments told the commercial department when a machine could be built, has now been replaced by the newer method whereby the commercial department tells the manufacturing department when a machine must be complete. Hence the modern superintendent and foreman must constantly be on the alert to know when to gear his department up or down.

Most superintendents and foremen know *how* to speed up or slow down production, but where they seem to fail is in knowing *when* and *where*. It is with this in mind that there has been worked out what is called, for want of a better name, a "Direct Labor Indicator," something that will tell each foreman when and where to apply labor. (See Figure 2.)

In a word, what has been attempted is to determine just how much work should be lying at any particular work station in order to be able to meet schedules.

The following rating scheme has been worked out:

A—*normal load*—just a little more work than a man can do, thereby giving him an incentive.

B—*overtime load*—when the load at any work station reaches this point, overtime must be applied.

C—*second shift load*—when the load reaches this point, a second shift must be applied.

D—*transfer, or third shift load*—when this point has been reached, emergency methods must be applied.

A direct labor figure in dollars-man-minutes or points, representing each of these degrees, is worked out for each work station.

Once a day a survey is made of each work station to determine the number of jobs in process, idle machines, and the dollars of direct labor at the particular work station at the moment.

With this information, together with the code worked out above, it is possible for the superintendent or foreman to tell at a glance what his action must be.

The success of this method will depend, of course, on the accuracy with which the normal load is determined. It will be arrived at by the foremen themselves.

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The dispatch station—how it is set up and operated in modern production planning—is the subject of Mr. Landy's tenth installment, scheduled for publication early in 1934

BEARING AND PEDESTAL SECTION
WORK STATION REPORT

Figure 2

		NORMAL LOAD	OVER-TIME	2D SHIFT	3D SHIFT TRANSFER	MONDAY				TUESDAY				WED	
MACH. No.	DESCRIPTION	A	B	C	D	LABOR (DIRECT)	JOBS RUNNING	IDLE STATION	RATING	LABOR (DIRECT)	JOBS RUNNING	IDLE STATION	RATING	LABOR (DIRECT)	JOBS RUNNI
101	BALLING MACHINE	5.00	15.00	20.00	40.00	7.00	2		B						
102	BALLING MACHINE	10.00	15.00	20.00	40.00	8.00	1		A						
103	HORIZ. BORING MILL	5.00	15.00	20.00	40.00	6.00	1		B						
104	HORIZ. BORING MILL	5.00	15.00	20.00	40.00	5.00	1		B						
105	ASSEMB. LARGE PED. AND BEARING	20.00	30.00	60.00	100.00	19.00	3		A						
107	6-IN. RADIAL DRILL - HORIZ.	10.00	15.00	20.00	40.00	9.00	—	X	B						
108	LAYOUT TABLE (S. BEAR. AND CAP)	5.00	15.00	20.00	40.00	4.00	1		A						
109	LAYOUT TABLE (L. BEAR. AND CAP)	5.00	15.00	20.00	40.00	6.00	2		B						
110	FINISHING SMALL BEARINGS	10.00	15.00	20.00	40.00	15.00	2		B						
111	FINISHING LARGE BEARINGS	30.00	45.00	60.00	100.00	27.00	3		A						
112	TUBE BENDING	5.00	15.00	20.00	40.00	4.00		X	A						
113	FINAL INSPECTION BENCH	0	0	0	0	2 Jobs	2		A						
114	SPEC. IRON FLOOR SETUP	0	15.00	20.00	40.00	20.00		X	C						
115	38-IN. BORING MILL	10.00	15.00	20.00	40.00	9.00	1		A						
116	5-FT. BORING MILL	10.00	15.00	20.00	40.00	8.00	1		A						
117	5-FT. MAXI. MILL	10.00	15.00	20.00	40.00	7.00	2		A						
118	5-FT. MAXI. MILL	10.00	15.00	20.00	40.00	8.00	1		A						
119															
120	HORIZ. MILL	10.00	15.00	20.00	40.00	9.00		X	A						
122	24-IN. ENGINE LATHE	5.00	15.00	20.00	40.00	6.00	1		B						
123	24-IN. BALLING LATHE	5.00	15.00	20.00	40.00	7.00	1		B						
124	30-IN. BALLING LATHE	4.00	15.00	20.00	40.00	3.00	1		A						
125	24-IN. ENGINE LATHE	10.00	15.00	20.00	40.00	9.55	1		A						
126	24-IN. ENGINE LATHE	4.00	15.00	20.00	40.00	3.00		X	A						
127	BALLING LATHE	5.00	15.00	20.00	40.00	4.25	1		A						
128	30-IN. ENGINE LATHE	4.00	15.00	20.00	40.00	3.75	1		A						
129	38-IN. ENGINE LATHE	0	5.00	15.00	20.00	5.25	1		B						
130	42-IN. ENGINE LATHE	5.00	15.00	20.00	40.00	4.75	1		A						
131	50-IN. BALLING LATHE	10.00	15.00	20.00	40.00	9.15	1		A						
132	42-IN. ENGINE LATHE	0	5.00	15.00	20.00	0	—	—	A						
133	BABBITT UNIT	5.00	15.00	20.00	40.00	4.50	1		A						
134	60-IN. GRAY PLANER	10.00	15.00	20.00	40.00	9.50	1		A						

Employee Representation in Chrysler Plants

More than 86 per cent of the 33,000 shop employees of Chrysler Motors voted by secret ballot October 10 to adopt a joint council plan of employee representation. Under it employees and management will have an equal voice in deciding all matters concerning wages and working conditions. Published here in its entirety, the plan will serve as a guide to the increasing number of socially-minded executives who are looking to the works council as the best way of providing the machinery for collective bargaining. Those same executives, who have learned that the soundest proposals of management can fail unless properly sold to employees, will find in W. P. Chrysler's statement—reproduced on the two succeeding pages—a splendid example of the right way to present such a plan

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Purpose

THIS is a plan which provides an opportunity for the Employees to have an equal voice with the Management in deciding jointly all matters affecting wages and working conditions.

Its purpose is two-fold:

First: To establish a mutually satisfactory way of settling any differences which may arise between Employees and Management, including rates of pay, shop rules, working conditions, safety, hours of labor, plant sanitation, Employees' transportation and recreation.

Second: To provide a means of friendly and lasting cooperation between Employees and Management on the basis of mutual confidence and understanding.

In order to carry out these aims, the plan provides:

1. That the Employees may nominate and elect by secret ballot Employee Representatives to deal with the Management on all matters of wages and working conditions.

2. That the Employee Representatives so nominated and elected may serve on a Joint Council with an equal number of Management Representatives, which Council shall hear and dispose of any questions referred to it by the Employees or the Management.

3. That such a Joint Council be established in each of the following divisions: Plymouth, Dodge Main, Jefferson, Kercheval, Dodge Forge and Truck, Highland Park, Newcastle, Chrysler California and Chrysler Engineering.

4. That in the event the Joint Council cannot reach a satisfactory settlement itself, or in consultation with the Operating Vice-President, the matter shall be referred to arbitration for decision, which decision shall be binding on all concerned.

5. That mutually satisfactory procedure be established for the prompt, regular handling of any matters arising between Employees and Management through joint determination of the facts and joint decision in which Employees and Management shall have an equal voice.

Nominations and Elections

1. For the purpose of nominating and electing Employee members of the Council, each of the divisions named above shall be divided into Voting Districts. Voting Districts shall be determined so as to include substantially an equal number of shop Employees, and with due regard to departmental classification of the plant.

2. Adjustments in Voting Districts, whenever necessary to secure complete and fair representation, shall be made in accordance with the recommendations of the Joint Council.

3. Employee members of the Council shall be nominated and elected by the Employees by secret ballot.

4. All shop Employees of the Company who are on its payrolls on the day of nominations shall be entitled to vote at nominations and at elections.

5. Any shop Employee of the Company who has been on its payrolls for a period of at least one (1) year immediately prior to the day on which nominations are made (including time lost as a result of illness or lack of work), who is twenty-one years of age or over and who is an American Citizen, shall be qualified for nomination and election as an Employee Representative.

6. To be eligible for nomination as Employee Representative from any Voting District, the Employee must be employed in such Voting District.

7. Officials of the Company and persons having the right to employ or dismiss, or regularly holding purely supervisory positions, shall not be eligible for election as Employee Representatives or qualified to vote for Employee Representatives.

8. Nominations and elections shall be conducted in each division annually during the month of October.

9. Nominations shall be made on any day in October,

W. P. Chrysler Offers Employees Equal Voice with Management on Wages, Working Conditions

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To the Employee:

As a former shop-worker I have long looked forward to the time when the Employees and the Management of the Chrysler Corporation would sit down around a table to discuss and decide matters of mutual interest to all of us.

I have always believed that if we could do this in a spirit of friendly understanding and confidence in each other, we would accomplish a great step forward in promoting the kind of relationship we all want in this industry.

It seems to me that this Company has now reached such a degree of understanding and mutual respect between Employees and Management that we can consider together practical means of giving effect to a plan which I believe will insure lasting co-operation, good will, and prompt, fair settlement of any questions that may arise among us.

It is inevitable in a large organization such as this that from time to time questions should arise. The aim should be to provide a mutually satisfactory method of dealing with these matters, of jointly establishing what the facts are and then, jointly, in a friendly, co-operative way, decide what we are going to do about them.

I have enough confidence in the fairness of men to believe that when they know the facts and have an equal voice in deciding matters that concern them they will come to decisions that are fair and reasonable. It is for that purpose that I am proposing for your consideration a plan of Employees' Representation in our plants. This plan is described in a leaflet which each one of you will receive.

I ask you to read it carefully, to study its mutual advantages and then to decide by secret ballot whether or not you want to adopt it.

I can best describe its advantages by quoting from the purpose of the plan itself:

"This is a plan which provides an opportunity for the Employees to have an equal voice with the Management in deciding jointly all matters affecting wages and working conditions.

"Its purpose is two-fold:

"First: To establish a mutually satisfactory way of settling any differences which may arise between Employees and Management, including rates of pay, shop rules, working conditions, safety, hours of labor, plant sanitation, Employees' transportation and recreation.

"Second: To provide a means of friendly and lasting co-operation between Employees and Management on the basis of mutual confidence and understanding."

In order to carry out these aims the plan provides:

"(1) That the Employees may nominate and elect by secret ballot Employee Representatives to deal with the Management on all matters of wages and working conditions.

"(2) That the Employee Representatives so nominated and elected may serve on a Joint Council with an equal number of Management Representatives, which Council shall hear and dispose of any questions

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and elections shall be held within four (4) days thereafter, and during the same week.

10. Nominations and elections shall be conducted by the Employees themselves in accordance with rules and regulations prescribed by the Joint Council, and with only such assistance from the Management as may be requested.

11. Nominations and elections shall be so conducted as to avoid interference with the voters in any manner whatsoever, and so as to prevent any fraud in the casting or counting of ballots.

12. On the day of nomination, each shop Employee of the Company then qualified to vote shall be furnished with a ballot stating the number of persons he is entitled to nominate, and such voter shall write on his ballot the names of the persons in his Voting District whom he desires to nominate for election as Employee Representatives.

13. Each Voting District shall be entitled to one Representative in the Council. Each shop Employee shall be entitled to nominate two qualified Employees as candidates for election as Representatives in the Council.

14. If any voter puts the name of the candidate on his ballot twice it shall be counted only once.

15. If any voter nominates more than two candidates his ballot shall be void.

16. After the Employees have nominated candidates, the nominating ballots shall be counted and the two Employees who have received the highest number of votes at the nominations shall be candidates for election.

17. On election day each duly qualified voter shall be furnished with a ballot containing the names of the candidates for Employee Representative in his Voting District.

18. Each voter shall indicate his preference by placing a cross (x) opposite the name of the candidate of his choice.

19. Each voter shall deposit his own ballot in a box provided for the purpose by the Joint Council and the ballots shall be counted under the direction and supervision of the members of the Joint Council.

20. The candidate in each Voting District who shall receive the highest number of votes shall be declared elected as the Employee Representative for that District.

21. In the event of a tie, seniority in the employment of the Company shall determine the choice.

22. In the event of a controversy arising concerning any nomination or election, it shall be referred to and decided by the Joint Council.

23. The candidate running second in number of votes cast at election for Representative shall serve as Alternate to the elected candidate as District Representative.

tions referred to it by the Employees or the Management.

"(3) That in the event the Joint Council cannot reach a satisfactory settlement itself, or in consultation with the Operating Vice-President, the matter shall be referred to arbitration for decision, which decision shall be binding on all concerned.

"(4) That mutually satisfactory procedure be established for the prompt, regular handling of any matters arising between Employees and Management through joint determination of the facts and joint decision in which Employees and Management shall have an equal voice."

You will find that this plan enables the individual Employee to get a fair and prompt hearing by his supervisors and if he cannot get a satisfactory settlement from them, then a review by a Joint Council in which his fellow Employees have an equal say with the Management in disposing of his case.

The whole purpose of the plan is to promote such a relationship in our plants as will insure the Employees a square deal and encourage their willing co-operation in advancing the Company whose interests concern every one of us.

Read the plan carefully. I am going to ask you to vote "yes" or "no" whether you want it.

In order that this election may be held under Employees' auspices, entirely independent of the Management, the Chrysler Industrial Association, which as you know is an organization of the Employees themselves, and has their confidence, has kindly consented to conduct the election on the plan. If the plan is adopted the first election of Employees' Representatives under the plan will also be conducted by that Association. The elections thereafter will be conducted by the Joint Council.

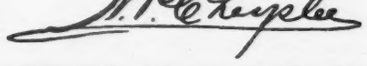
If the majority of the Employees say "yes" the plan will be put into effect and you will have an opportunity to nominate and elect representatives to deal with the Management on an equal basis in discussing and deciding all questions that may arise.

Let me emphasize a few important points for your consideration. I want to call particular attention to the paragraph in the plan guaranteeing independence of action on the part of Employee Representatives. This paragraph reads:

It is understood and agreed Employee Representatives shall be free to discharge their duties in an independent manner, without fear that their individual relations with the Company may be affected in the least degree by any action taken by them in good faith in their Representative capacity.

This plan is a simple and clear method whereby we can mutually consider as equals all questions that vitally concern us in our relations with each other. In offering this plan I want it distinctly understood that every Employee, regardless of his membership or non-membership in any organization, has a right to participate in it.

I regard this plan as one of the most important things this Company could do in the interests of the Employees themselves. If I were again a shop Employee I would vote wholeheartedly for it and I hope that you, too, will vote in favor of it.



Term of Office

1. Employee Representatives shall be elected for a term of one (1) year, and shall be eligible for re-election.

2. An Employee Representative shall be deemed to have vacated his office as such—

a. Upon severance of his relations with the Company.

b. Upon transferring from one Voting District to another.

c. Upon his appointment to such a regular position as would make him ineligible to qualify as a voter or as an Employee Representative.

d. Upon being absent for more than two consecutive meetings unless such absence has been excused by the Chairman of such meetings.

3. In case a petition is filed with the Chairman of the Joint Council, signed by not less than one-third of the Employees of a Voting District, asking for the recall of their Representative, a special election by secret ballot shall be held in that Voting District under the direction of the Joint Council, to decide whether such Representative shall be recalled or continued in office.

4. If at such election a majority of the Employees in the Voting District vote in favor of recalling their Representative, then his term of office shall immediately cease; otherwise, he shall continue in office.

5. Vacancies in the office of an Employee Representative for which there is no Alternate may be filled for the unexpired term, in the discretion of the Joint Council, by special election conducted in the same manner as the regular annual elections.

Joint Council

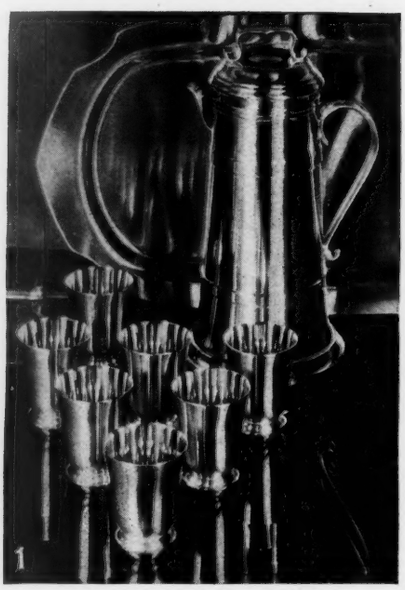
1. Those qualified candidates, elected as Employee Representatives in the various Voting Districts of each of the Plant Divisions outlined above, shall constitute the Employee members of a Joint Council for that Plant Division.

2. Within one (1) week after the annual election of Employee members of the Joint Council, the Management shall appoint representatives of the Management to meet with the elected Employee members. At no time shall the number of Management Representatives exceed the number of elected Employee Representatives in any Joint Council in any Plant Division.

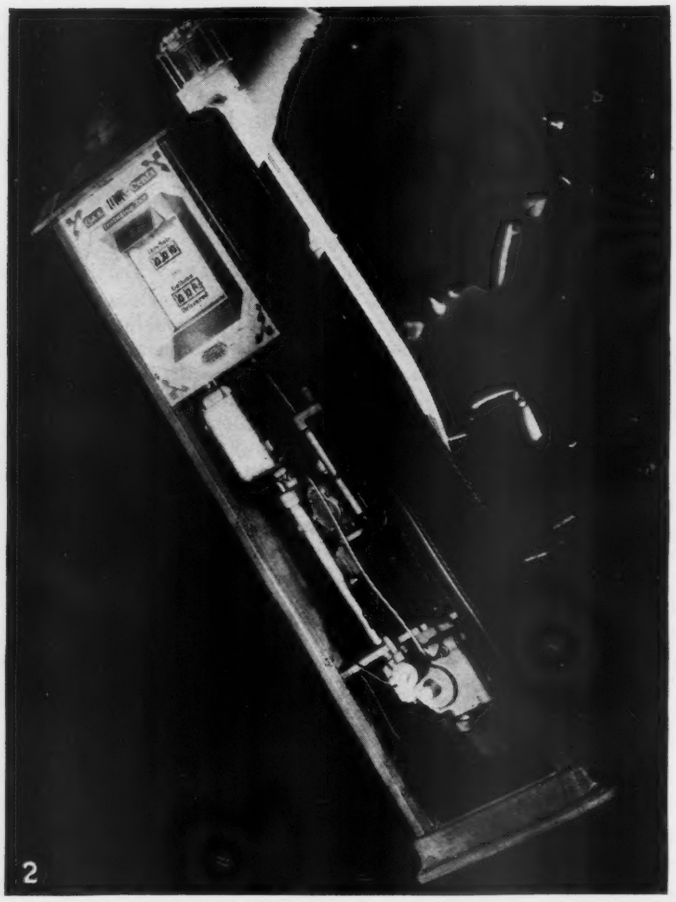
3. The Company shall also appoint a Special Representative (who shall be known as Management's Special Representative) who shall keep in touch with both the Employee Representatives and the Management, and shall represent the Management in negotiation with such Representatives.

(Continued on advertising page 30)

Costs High? Sales Low? Look to Materials



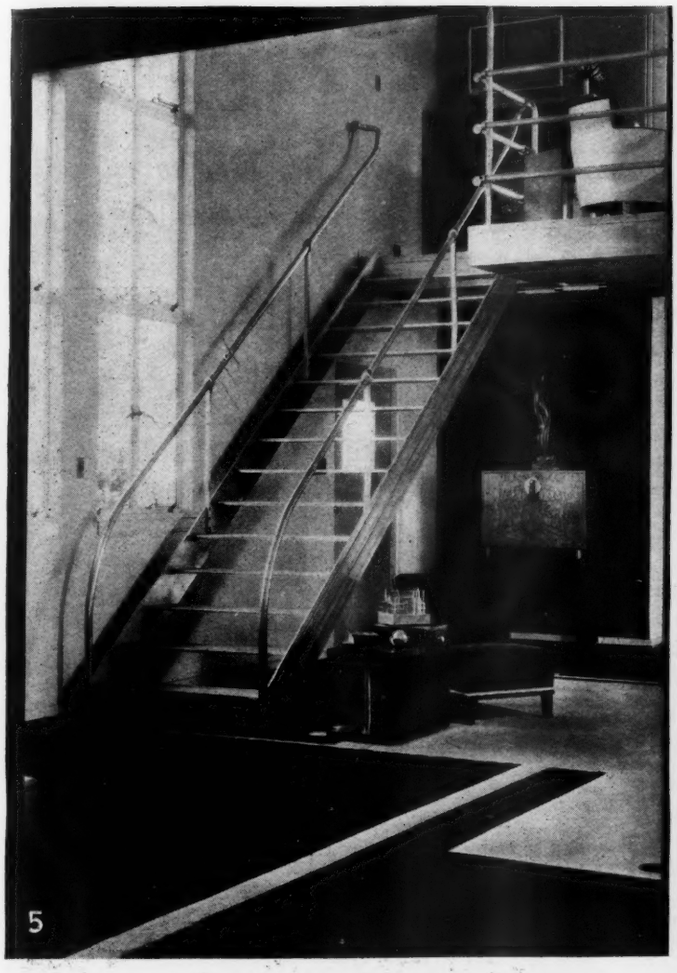
1 To insure pleasant and continued observance of an old American custom, stainless steel cocktail shaker, cups, and tray are hereby indicated and recommended

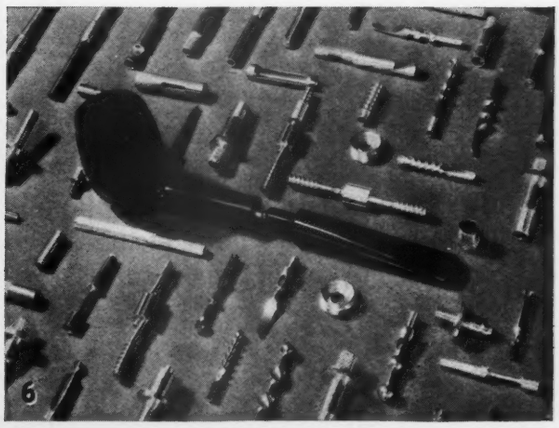


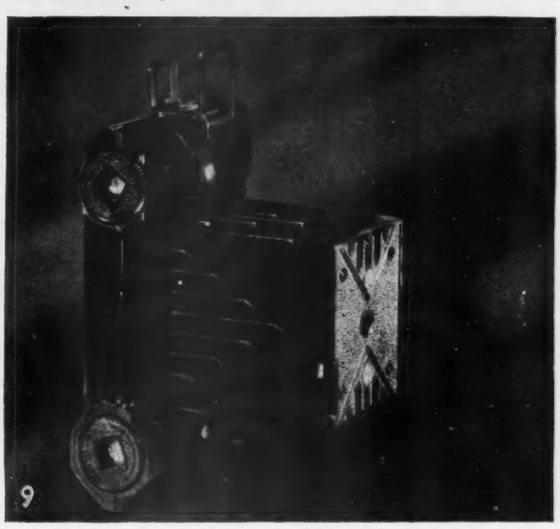
2 Buy gas by dollar, by gallon. This pump does all the arithmetic, registers the answer both ways. Most of its working parts are zinc die-castings

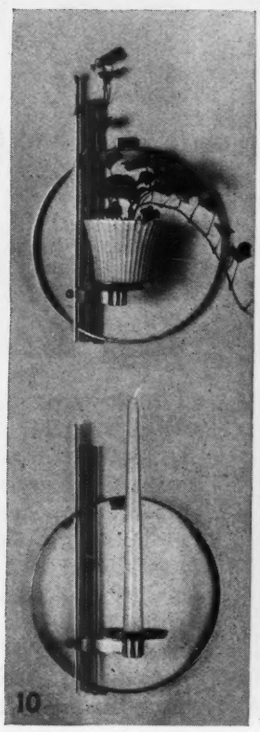
3 Rome Manufacturing Company goes after the teakettle trade with one in copper that grows old gracefully. Its plastic grip is molded integrally with the bail

4 Hospitable husbands who will step into the kitchen to crack ice and squeeze lemons can't hurt the sink or cabinet top that's made of nickel-copper alloy









5 For the modern house, a modern staircase that is beautiful in its very simplicity. Aluminum is the material used by James S. Kuhne and Percival Goodman, who designed it

6 No pipe is complete unless it has a gadget that insures a cool, dry smoke. Each of the many parts illustrated is an aluminum screw-machine product

7 No secret to steeping tea in the pot which Walter Dorwin Teague has done for Corning Glass. The color you like is the color you get. Black plastic handle

8 Molded in colored plastic, this safety razor is complete in one piece—nothing to take apart or screw together. Built to fit the hand's contour

9 For four bits you can go out and buy a Norton molded plastic camera that takes sharp, clear pictures in spite of the fact that it is only three inches big

10 Ivy by day, candle by night is the order of events with this Chase wall bracket. In either polished copper or polished brass with blue-green enameled rods

How to Get at the

Robert W. Drake

Mechanical and Electrical Engineer, De Kalb, Ill.

Studies to determine how power application costs can be reduced require technical skill and experience, but the prime requisites are vision and judgment. Maximum value from such studies can come only from one who does not, day after day, walk past the greatest opportunities for improvement, without seeing them

▼

IN THE widespread efforts to reduce manufacturing expenses, the cost of power and the accompanying costs of distribution and application cannot escape scrutiny. In some instances where existing power systems are antiquated, ill-planned, or inadequate, these costs are of primary importance.*

Economy in the use of power may be purchased at too high a price. It is essential that manufacturing considerations be given equal or greater weight than savings in power and maintenance costs. In many instances the fixed charge on the necessary investment is also of great importance.

In all too many cases, a decision to make certain changes is based upon one or two advantages without adequate consideration of all pertinent points.

The problem of modernization of power distribution and application equipment presents itself in such forms as:

1. The old plant which must be completely modernized to hold a competitive position in its industry. In extreme cases, replacement of the whole power system is warranted. Such a situation may be considered from much the same standpoint as in a new plant.

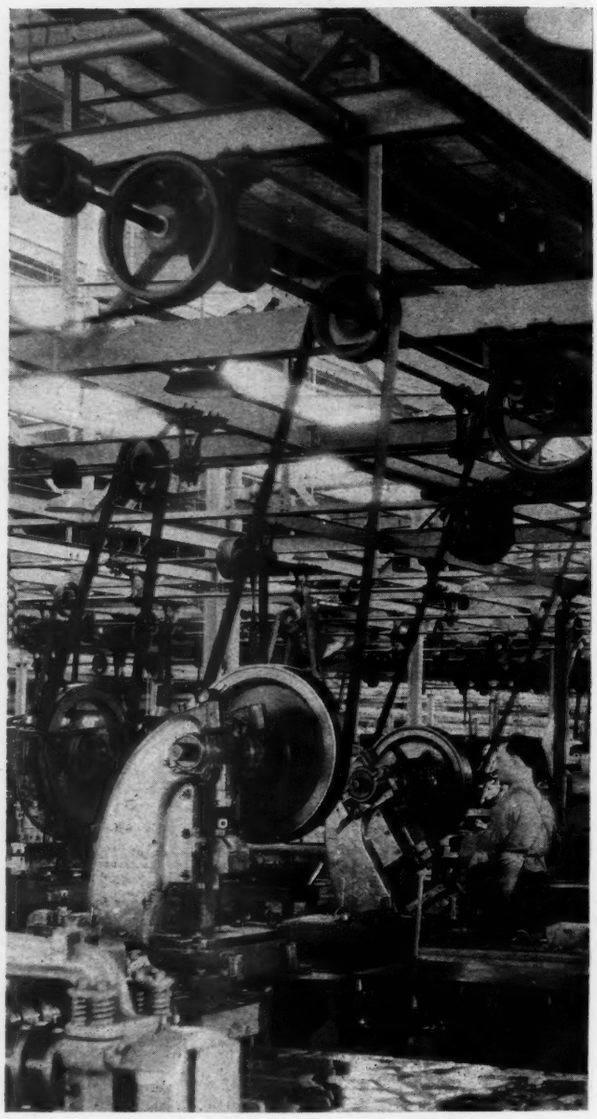
2. At the other extreme is the modern plant searching for detail changes that will cut costs.

3. Between these two extremes lie the majority of plants. A wholesale scrapping of the present power equipment is neither desirable nor economically warranted. On the other hand, the present equipment is by no means modern, and many opportunities exist for a substantial annual saving at moderate expenditure.

4. The plant that is changing from home-generated to purchased power, or *vice versa*.

When building a new plant, with the exception of canneries, sugar refineries, car shops, and similar factories which actually operate only a portion of the time, it is most economical in the long run to install the most efficient equipment available, with due consideration for ruggedness where the service is severe. Thus the problem in planning new work is chiefly a matter of applying the equipment.

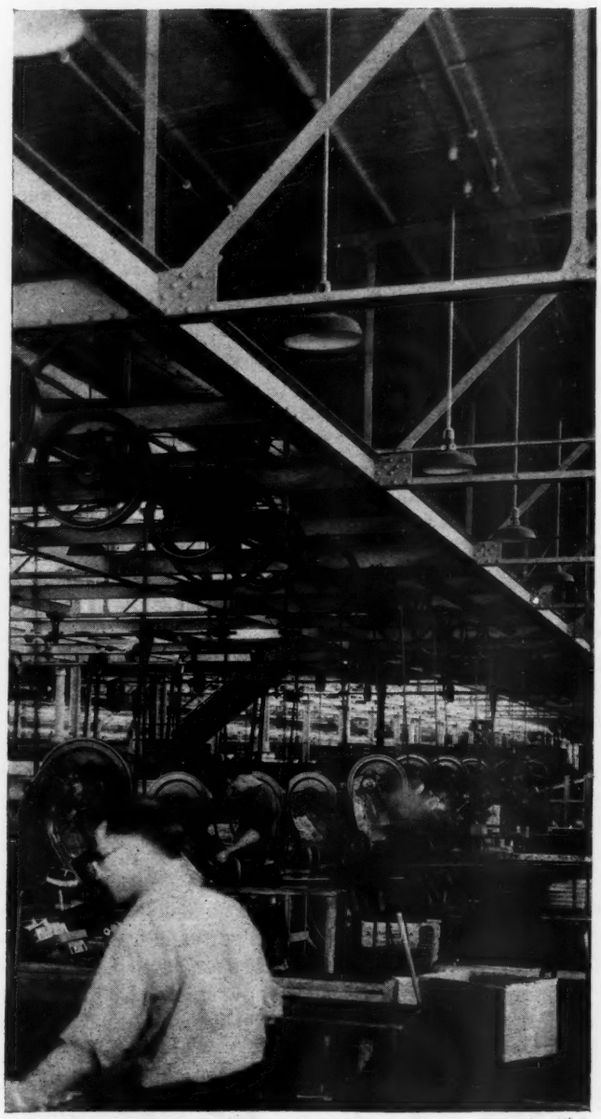
*See "Changed Drives and Stayed in Business," April, 1933.



In the fairly modern plant searching for detail changes which will show an attractive return, the problem may be attacked in a reasonable time only by selecting promising improvements for study, estimating the return on the necessary investment, and following up the most desirable projects with due regard for manufacturing considerations, which are frequently important but difficult to evaluate in dollars and cents. Here success depends upon vision in perceiving promising possibilities for improvement.

Constant association tends to make all of us blind to many matters which are of daily concern. They were

Hidden Gold in Power Drives



always so, and it never occurs to us that they could be improved. When someone is able to see these opportunities around him, there remains only the comparatively simple job of determining which of them will pay. In a later article a number of matters worth investigation in the majority of plants will be mentioned.

The situation in the third group of plants is the most difficult to handle. More than mere detail changes are called for, but complete replacement is warranted only in those few items where considerable savings are possible either in reliability or in power consumption.

It is not difficult to determine many changes that will decrease operating expenses, but they increase fixed charges also. The problem is, What items of expenditure will give the largest return in increased reliability, decreased manufacturing delays, decreased maintenance expense, and direct power savings? Obviously, the improvements possible depend upon conditions. A well-planned installation, systematically maintained, offers less opportunity for a striking saving than one in a plant where little thought has been given to such matters.

Of the total power input to electric motors driving production machinery, 12½ to 60 per cent is lost between the motor terminals and the driven machine. The percentage of loss is about the same whether the production machines are driven in groups or individually. With individually driven machines a greater proportion of the total loss is likely to be found in the motor than is ordinarily true of machines driven in groups, but it is offset by the increased loss in mechanical transmission devices.

The amount of power lost between the power lines and the driven machine is not independent of the type of manufacturing. There is no hope of reducing the losses in all plants to 12 or 15 per cent; this is an unusual figure for a single group, and almost unheard-of as a plant average. However, in the majority of industries not engaged in very light manufacturing 20 to 30 per cent losses in motors and mechanical transmission are attainable as a plant average, at least under reasonable production volume.

I believe that in the majority of plants which have made no extensive changes in power drive practice during the past fifteen years, the present motor and mechanical transmission losses can be halved. Usually the drastic treatment necessary would not be economically justified unless considerable other rehabilitation were to be carried out also. However, there are few plants in which worth-while power savings are not possible at moderate expense.

When investigating a problem in power application the information desired is:

1. What does it cost to do it now?
2. What will it cost after the proposed improvements?
3. What will be the saving?
4. What will be the cost of the proposed change?

Under (1) and (2) the following items must be considered:

(*a*) Cost of maintenance, repairs, and replacements.

(*b*) Cost of power wasted. (Various power losses).

(*c*) Fixed charges and investment, including necessary spare equipment.

(*d*) Cost of manufacturing delays caused by the equipment in question. (Breakdowns and necessary delays for adjustment, etc.)

(*e*) Loss through deficiency in performance of equipment. (Belt slip and creep, material spoiled or reworking

required due to oil drip from hanger bearings, loss in production due to drop in motor speed on load peaks, and so forth.)

On item (*a*) the accounting department can give little assistance. Total cost of maintenance, repairs, and replacements for all equipment is available. Figures may be available for the motors and mechanical transmission as a whole, although it is unlikely. Detailed costs for the equipment involved in any proposed change are not to be had.

Power losses (*b*) of the equipment may ordinarily be determined fairly accurately with simple testing equipment.

In bearing friction losses, where the loss in each unit is small and a test in the field includes so many other losses as to be useless, laboratory test data are occasionally available.

The accounting department can ordinarily furnish much of the data on original cost and/or present value necessary to determine (*c*)—fixed charges.

Items (*d*) and (*e*), cost of delays, and losses through deficiency in performance, are in many cases the most important.

Study of items (*a*), (*b*), and (*c*) is often limited to one representative department, although the conclusions are applied throughout. In items (*d*) and (*e*), this cannot be done. Delays due to motor failure, for example, are so irregular in occurrence that it is necessary to average many motors over a period of several years.

A fair estimate of the total number of manufacturing delays of an hour or more for a few years back may be obtained by requiring each foreman to turn in a list for his department.

True cost of manufacturing delays is exceedingly difficult to determine. The cost of repairs is frequently negligible in comparison with indirect costs due to disarrangement of schedules and time lost by the men, cooling of material in process, and so on.

In actual practice, determination of the advisability of a suggested improvement is not often so laborious as the above discussion would indicate.

If some judgment is used as to which items to investigate first, it will often be found that one item of saving predominates, and only this one item requires careful investigation. Other items may be estimated roughly. It makes little difference in such cases whether the change will pay out in two or in five months.

Brief study of other seemingly promising proposals will indicate an unattractive return on the investment. If preliminary study indicates no likelihood that further investigation would show unexpected savings through decrease in manufacturing delays or elimination of deficiencies in performance, the matter may well be dropped. It is, however, in these two items that the greatest possibility lies for overlooking possible savings. As an example, ball bearings installed to reduce friction losses frequently result in greater savings in reduction of product spoiled through dripping lubrication and in oiling labor.

Ingenuity and experience in plant operation are essential in obtaining results in this work. Most of the data must be obtained by indirect methods; much of it must be rough. A trained accountant may be of great assistance in running down records of investment costs, but the precise training of the auditing or cost department is a handicap in most cases.

Here is an example. A plant engineer was about to order 50 motors for a plant extension, but decided that he might use 50 underloaded motors from the existing plant and buy 50 smaller motors to replace them, thus improving the power factor, reducing the motor losses on 50 existing drives, and saving enough money on motor costs to pay part of the labor cost of the shift.

He sent a list of the motor sizes and speeds required to the two operating foremen, requesting them to advise him of any underloaded motors of those sizes in operation.

One man started to test every motor of corresponding size under his care—about 1,200 in all. He found that in many cases the heaviest load was seasonal and no worth-while test was possible except in the busy season.

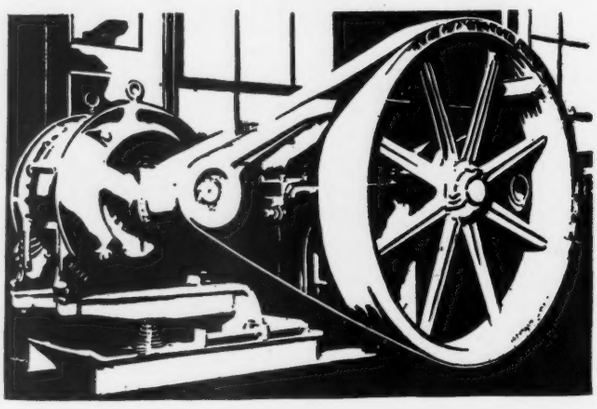
The other man realized that haste was essential, called his motor inspectors together, and compiled a list of all the motors which they knew had never been hot. Tests on these motors scored almost 100 per cent bullseyes! More than 100 underloaded motors were eliminated. A 7½-hp. or 10-hp. motor would be purchased to replace an under-loaded 20-hp. replacing an underloaded 30-hp. or 40-hp., which would be turned over for the new extension. The prize performance was a series of such moves resulting in the purchase of a 1- or 2-hp. motor and removal of one of 75-hp. rating.

Oftentimes no analysis is made of probable savings or their relation to first cost. In old plants where production costs are so high that something must be done, the problem of cutting power costs is frequently approached by copying the practice of one of the most successful units of the industry, at least in its principal features. This procedure may result in so great an improvement that the user is satisfied, but it seldom gives the greatest possible return for the money expended.

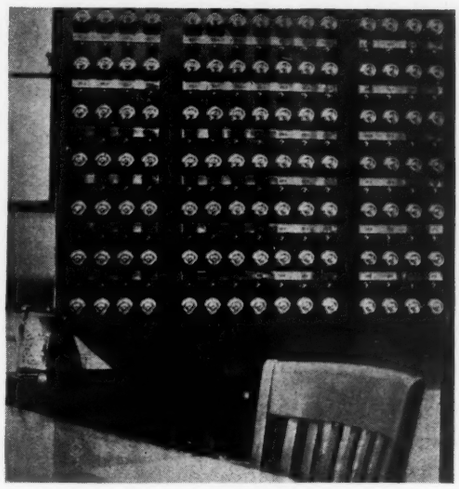
In many cases improvements in the plant power system and in the application of power to the machines are, and should be, made in connection with modernization of manufacturing procedure, including machine arrangement and materials handling.

Extensive economic analyses indicate that manufacturing or production considerations usually should take precedence over minor savings in power cost and maintenance expense and, in most cases, over first cost.

A later article will show how methods of power application may affect production in ways that are not apparent on first consideration.



Can't Go Wrong



To err is no longer human at Jewel Tea; it's impossible—all because visual control boards keep the factory from getting signals crossed

•

No switches in quality here. The coffee you order is the coffee you get

A PROBLEM in quality arises in any plant producing more than one grade of a product which cannot be graded by its appearance. There is always the possibility that Grade A and Grade B will somehow get switched, so that what the customer eventually purchases is not the grade desired.

This problem remained for a long while not satisfactorily solved in the coffee roasting, grinding, and packing departments of Jewel Tea Co., Inc., Barrington, Ill. To be sure, the grades were successfully kept separate. But the result was attained at a considerable expense in records, in mental strain, and in running around to check and double check at every stage of the processses.

A recent development has simplified the whole problem so that it is completely under control all the time, at a negligible cost. At the focal points in the plant, the entire story of just what coffee is at just what stage can be read by anyone who passes. And the plan devised to bring this about is of a sort which might easily be applied almost "as is" to the similar problem in plants handling entirely different lines of production.

The plan is essentially something like a schedule board. It differs from that old favorite, however, in that it is controlled electrically, and gives the same information simultaneously wherever required. The system has two nerve centers, one in the roasting foreman's office and one in the grinding department a floor below. And it has nerve ends over the various pieces of equipment which enter into the production routine.

In the roasting foreman's office is a panel board made up of 105 key-turn switches, each switch controlling a telltale lamp, whose location signifies the grade of coffee. Thus if Jewel Best, JB, is in No. 1 bin, a different switch is turned, and a different telltale lighter, from that which would show that No. 1 bin contains JS or JC coffee. Metal strips stamped with the code are fixed beneath each horizontal row of switches. The switches can be turned only by a key. To prevent tampering and to concentrate responsibility, the roasting foreman has the key and makes all "entries" in person.

A similar panel is on the grinding floor. The boards are so wired that when the board on the roasting floor is lighted to show a given condition, the other board shows identically. The switches are two-way, and when the grinding floor makes a shift it shows up accordingly in the coffee testing room.

After a batch of coffee is tested, the roasting foreman designates the bin in which it is to be put. Let us say he lights up the panel to show that JB is to go into No. 1 bin. The batch is run into the bin immediately. And as the two telltales lighted up to show this information, there was automatically lighted up on a sign over that particular bin the word "BEST." Thus the man in charge of granulators in the grinding room sees at a glance that this grade of coffee is in No. 1 bin. Or if he wishes a bird's-eye picture of the whole situation, he finds this confirmed by the telltale on his panel board.

When the production department calls for JB coffee on Granulator No. 3, the granulator man opens the slide from No. 1 bin. At the same time he turns the switch with his key, and thus registers on both panel boards that Granulator No. 3 is running on JB coffee from Bin No. 1. Moreover, the signboard over Granulator No. 3 lights up with the word "BEST," showing that this machine is ready to run on JB. When he opens the slide, he illuminates the word "OPEN" above the granulator, and illuminates the proper telltale lamps on the panel boards.

Thus, on looking at any particular piece of equipment, anyone can see just which coffee it is running on. And on looking at the panel board on either floor he has a complete picture: Bin No. 1, JB coffee, slide open. Granulator No. 3, working on JB coffee from Bin No. 1. Presently when the packaging line begins to operate on this coffee from this granulator, the appropriate switch is turned to show that the packaging machine is working on JB coffee—and signboards above the packaging machine tell this story.

Since the plan was put into effect, it has eliminated errors. Likewise, it has made the check-up easier by doing away with legwork.

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

L. C. MORROW, Editor

NOVEMBER, 1933

•

Executive Control

FOR THE new deal, a new executive control, say some executives. Meaning that management must know what's on the worker's mind.

They recognize the possibility of having to deal with the collective-bargaining mental attitude, and propose that a works council may be a good cooperating tool.

It's something worth serious consideration, the operation of a works council alongside a trade union. The policy of reasoning things out with employees, characteristic of the ideal works council, might offset the "demand" tendency of the trade union, bring about acceptable balance, peaceful operation.

•

Efficiency

WHAT is going to happen to labor-saving machinery, motion study, wage incentive plans—in a word, "efficiency" under the New Deal? Let us examine the basic facts.

Any development that increases the product of an hour of labor is socially desirable. Progress is but the history of such increments. There can be no question of stopping growth; there *can* be a question of controlling it.

Control is possible to a monopoly. When the Bell telephone system adopted the automatic switchboard, the displacement of old equipment was progressive and timed to use up the equipment and ease the shock of the personnel adjustments.

The individual employer in a keenly competitive market is all too often helpless. He is driven by the remorseless need for lower costs.

The President's plan to encourage industry to govern itself has already shown its power to end abuse, such as child labor, against which the individual employer stood helpless. Collectively, industry can, if it will, end much of the planless chaos of competition which has proved so destructive in the past, can remove from technological advances much of their needless social cost. But it cannot do so by reverting to inefficient methods and equipment.

We must not confuse the issue. What is needed is not the cessation, but the control, of progress. It must not be forgotten that four years of almost untouched obsolescence is to be made good, and that the recovery of large sections of industry awaits the resumption of purchases of capital goods.

The work of the cost reduction engineer must go on. Shorter hours and higher wages will indeed increase the necessity for such work. The individual is not to be relieved of the need to compete.

•

Equipment

"BUY CONSUMER goods now," the government is saying. That's right; of what use additional purchasing power if not exercised? Moreover, prices are rising, and delay means higher cost.

The same logic applies as to durable goods —let's call them capital goods. The price trend is upward; the capital goods industries need the business; dynamic, rather than potential, purchasing power is essential.

Buy now if it is to your advantage to do so. That immediate buying will be to the advantage of much of industry is an inescapable conclusion when we consider four years of obsolescence and mounting manufacturing costs.

Before there can be buying of capital goods, there must be recommending. A revival of courage on the part of plant men is in order. Let them go over again the recommendations for equipment that they made, or wanted to make, one, two, and three years ago; prove again that the recommended equipment will pay for itself; once more make serious, definite requests for the appropriations.

No appeal for altruistic action is intended. Follow selfish motives only, by all means. Any plant that has no need for modernization, rehabilitation, cost-cutting equipment, has reason to buy only maintenance equipment. The number of such plants is negligible—the others, by strictly selfish action, can become a very large market for capital goods.

Handling Men

ACCORDING to the present position of direction-indicators, the problems involved in handling men are changing somewhat. There is something to be done toward training executives, supervisors, and foremen to the end that they will know how to deal with workers having a "collective mind."

•

Elder Employees

ACCELERATING the work pace tends to lower the age at which the worker can't keep up. What to do with these "elder employees"?

Two possibilities. Some of them can be made into supervisors, valuable because of their experience and judgment—an out for management.

Some of them can be given easier jobs, usually with less pay. It's an out for the worker, and can be a very satisfactory one if he has prepared himself mentally to place a foot on the shelf instead of the ladder.

In connection with the second "out," possibly management has some educational work to do.

•

Raw Material

THERE reaches us the story of the plant that put a bunch of college graduates to work on spec. They were given jobs in the shop, no promises were made.

They're there for observation. Management has its eye on them as material for supervisory and executive jobs.

Looks like a splendid move.

•

Profits and Power Costs

IN MOST plants the cost of buying or making power and applying it needs investigation. Whether power is generated or purchased, the unit cost is not necessarily fixed. Many plants operating obsolete or inefficient generating equipment have found that costs could be lowered considerably by buying their power. Others have found that they could save money by generating their own.

Comparatively few plant men realize how much can sometimes be saved by study of the contract with the power company to determine, first, whether it is the most advantageous form of contract to which they are entitled and, second, how they can best meet or take advantage of its provisions.

There still remains the important problem of utilizing electrical energy to turn the shafts of production machines. At every step in the process there are many opportunities for loss and inefficient use of power. Some of the losses are electrical, as in transformers, distribution lines, and motors; others are mechanical, in bearings and transmission devices. Together they often account for a surprising proportion of the total power paid for.

There is little to be lost, much to be gained, by a thorough study of the power problem.

•

Technology

REGARDLESS of its merit, if today's attitude of organized labor toward a 30-hour week prevails, there is a boom time ahead for engineers, inventors, and research men.

In the past, the shutting off of immigration, and the reduction of man power by transfer from industry to army, brought about increased demands for labor-saving equipment, cost-cutting and short-cutting methods.

The same thing will happen again, whatever the cause of a shortage of labor. The lid will be taken off technological development, and management will no longer have inhibitions.

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Training

OPPORTUNITIES for supervision have increased. With more people being put to work and the number of shifts increased, there are many more supervisory jobs.

Admittedly, plants are having difficulty finding men of executive ability. Most of the candidates are being taken from the ranks, which is as it should be.

But, for the most part, they are untrained, which is not as it should be. A good second line of defense, as typified in the supervisory personnel, is a part of the backbone of any organization.

Here is a situation that calls for a resumption of the training activities that were an accepted part of the program of the first-line plant a few years ago.

SHORTS FOR MANAGEMENT FOR MAINTENANCE

No Spoiled Batches

Why run the risk of spoiling batches? This scale records on a ticket not only the weight but the numerical designation of the ingredients being weighed. Since the ticket goes to the mixer with the material, there is complete assurance that every batch will meet specifications, no chance of losing materials or product through careless mixing

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Simple Repair for Burnouts Between Combustion Bars

L. A. Cole, Brantford, Ontario, Canada

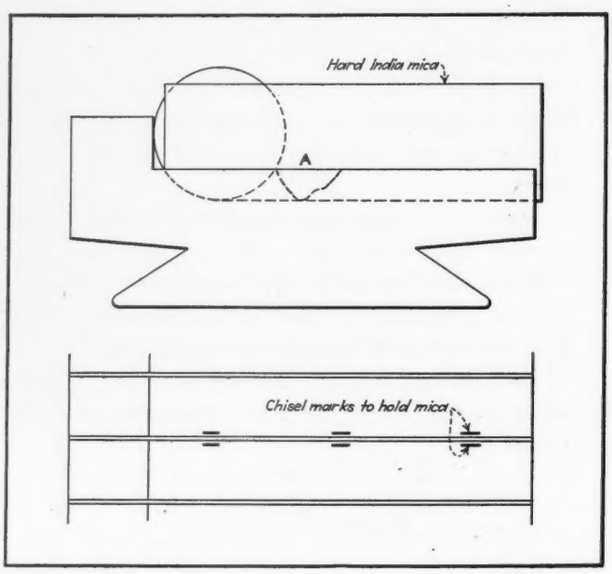
A quick and easy method of repairing burnouts between commutator bars is to undercut the mica below the deepest point of the burnout, as at *A* in the sketch. With undercut commutators insert a piece of hard India mica, as shown. This is best done by using three pieces, a rather thin one against the copper bar on each side to act as a guide for a heavier piece that fills the space between and is driven down carefully with a light hammer. Sometimes parallel pliers can be used to force the mica down.

The slot must first be shellacked to hold the mica in place. In addition, nick the edges of the bars with a sharp, narrow-pointed chisel. This will force the copper against the mica. Then the mica can be trimmed off even with the commutator surface by a sharp knife and a three-cornered commutator file used to undercut it. Undercutting should not be carried deep enough to destroy the effect of the open copper arch caused by the chisel indentations.

In the case of commutators that are not undercut, amber mica can be used but it has less strength to withstand forcing in place.

In any case, be sure that the inserted mica extends as far across the commutator surface as possible, at least beyond the brush travel surface. It is advisable to let it extend $\frac{1}{16}$ in. beyond the outer end of the bars.

I know of commutators repaired in this way that have



run for 14 years. It has been more successful than any filler we have used.

It is not necessary to turn the commutator, since the chisel marks can easily be smoothed off with a fine file.

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Eliminates Heating Trouble On Stranded Cable Joints

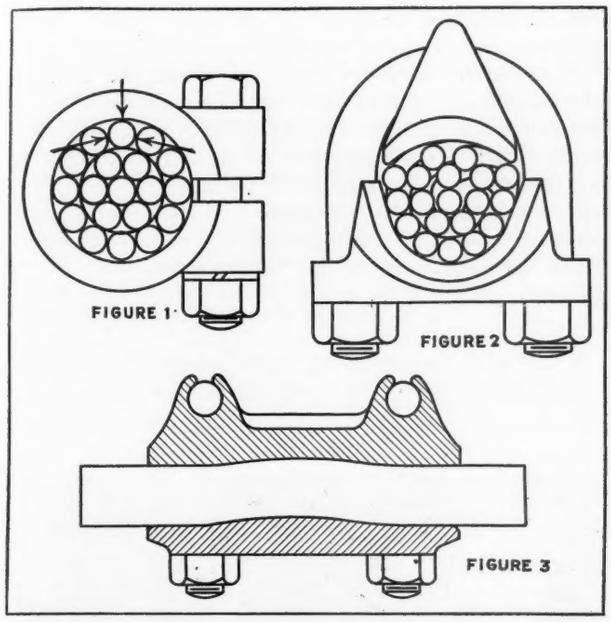
A. E. Nessler, Engineering Department
Delta-Star Electric Co., Chicago

An installation of 1,150,000 circ. mil stranded cables attached to copper bars with connecting lugs developed excessive heating. Investigation of the trouble disclosed that the lugs clamping the cable were loosening up, causing arcing and resultant heating.

These lugs were circular, and a test was made by clamping one of them as tightly as possible on a piece of cable by means of a vise.

The stranded conductor was then cut off approximately 12 inches from the lug and it was found that by flaring out the outer strands, the inner strands could be readily pulled out with a pair of pliers.

This seemed to be due to the fact that the circular



segment of the clamp (see Figure 1) tightly clamped the outer strands, binding them against one another, but seemed to transmit very little pressure to the inside or center strands. Besides being poor mechanically, this type of clamp was also electrically inefficient.

Tests were then conducted by using a clamp with a cross section as shown in Figure 2, side view Figure 3. As the clamp was tightened, the cable strands deformed, and the combination of this cross section and the longitudinal wave as pictured in Figure 3 insured better electrical contact of all wires and gave a good mechanical grip on every strand.

During the tests three men pulling on a loop formed on one of the inside or center strands could not cause it to slip. The original segment clamps were then removed and replaced, and the heating trouble was eliminated.

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Steel wire baskets coated with rubber resist the corrosive action of plating solutions.

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Self-Unloader

SOURCE: Boston Concrete Co., Cambridge, Mass.

Unloading 60 barrels of cement in bulk is a matter of 15 minutes or so with the special truck shown here. Reason, two screw conveyors driven by a 30-hp. gasoline engine. They're installed in the bottom of the body and are readily started when the truck is loaded. At the mixing plant, the cement is unloaded directly into the mechanical handling system.

Such a truck body is, of course, readily adaptable to the handling of other bulk materials.

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How to Construct Steam Hammer Foundations

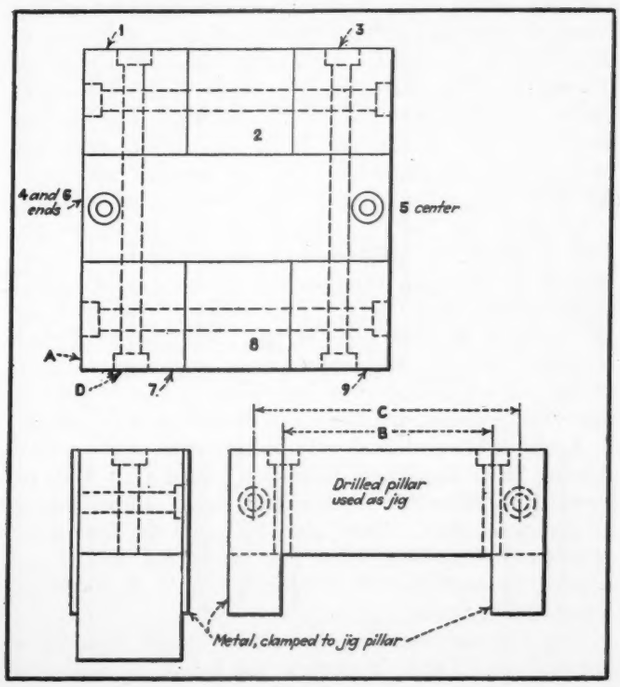
WM. C. BETZ, Master Mechanic
Fafnir Bearing Co., New Britain, Conn.

The size and work of a steam hammer determine in part how the anvil base shall be made to resist rapid deterioration.

If a heavy hammer (say 2,000-lb.) is mounted in the conventional way, i.e., with the frame on concrete foundations and the sow or anvil block also on concrete, the wood facing will be pounded to pieces in very short order. On the other hand, for a very light hammer (say 200- to 300-lb.) such a base would last from 3 to 5 years.

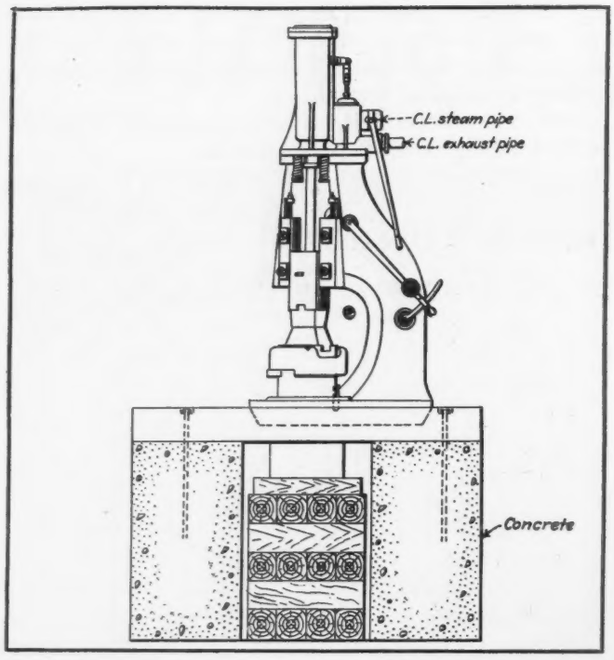
Another cause of rapid deterioration in a wooden anvil base is dry rot due to using untreated wood and lack of provision to keep the wood pile aerified. Aerifying may be accomplished by using coarse crushed rock for filling in around the wood base, in place of earth, sand, or cinders.

In setting up any hammer frame, the base should be mounted on substantial creosoted pillaring of oak or



other close-grained semi-hard wood of from 10x10-in. to 16x16-in. section, with the ends resting on concrete foundations to which the whole is bolted. See drawing of hammer and foundation.

The foundation of the anvil block should consist principally of heavy, creosoted oak pillars laid alter-



nately lengthwise and crosswise, with the layers bolted together. The wood foundation should be laid to a depth of from 2 to 6 ft. (according to the size of the hammer) when resting on good solid clay, rock, or concrete. If no natural solid base is encountered, one should be made by filling in crushed rock and covering with clay.

As to the wood, oak pillars of 10x10-in. or 12x12-in. section are best. For shimming, maple planking will be found to take the shock of the pounding as well as anything that can be used. All foundation wood should be thoroughly creosoted to prevent rapid decay and segregation of fibre due to the terrific pounding. The finished upper surface of the pile must be parallel with the hammer face, so that when anvil and hammer make contact they will come together over their entire surfaces.

To drill and bolt the pillars so that all layers are even, I proceed as follows: Lay out and drill one pillar section as illustrated, being sure to have the holes spaced equally from both edges. This section I use as a jig by which to spot the holes in the other pieces. It will be noted that only the pieces whose sides face outward in the pile are drilled from both sides *A* and *D* (in this pile of nine pieces, numbers 1, 3, 4, 6, 7, and 9); pieces 2, 5, and 8 being drilled only on one side to the widest spacing as at *C*. These holes are drilled $\frac{1}{8}$ to 3/16 in. oversize to allow for leveling each layer before bolting all layers together. Note, also, that only the four outer pillars are counterbored for bolt heads and nuts, 4 and 6 being counterbored for *C* spacing, and 2, 5, and 8 not being counterbored.

The hammer drawing shows the anvil foundation for 400- to 1,500-lb. hammers; the height of layers for hammers of these sizes should measure from 3 to 6 feet.

On heavy installations the base of the anvil block is made by driving creosoted round piles of hard wood into the ground from 6 to 12 ft. and placing on top of these piles the bolted floor of square oak pillars from 3 to 4 ft. thick. To form a good seat for the platform, crushed stone is filled in between the piles to a level with the tops, and on top of this a layer of from 2 to 4 in. of clay soil is placed and tamped flat.

To bring the anvil block to a solid seat, the hammer may be used on its own power for a short time. For this reason it is always well to have clay earth under and next to the wood piling regardless of what else forms the base of the wood foundation for the anvil block.

In specifying creosoted wood I refer to wood that has been thoroughly impregnated in a vat or creosoting drum, and not merely applied with a brush.

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A Cleveland manufacturer of small tools uses movies to teach customers how to use his products.

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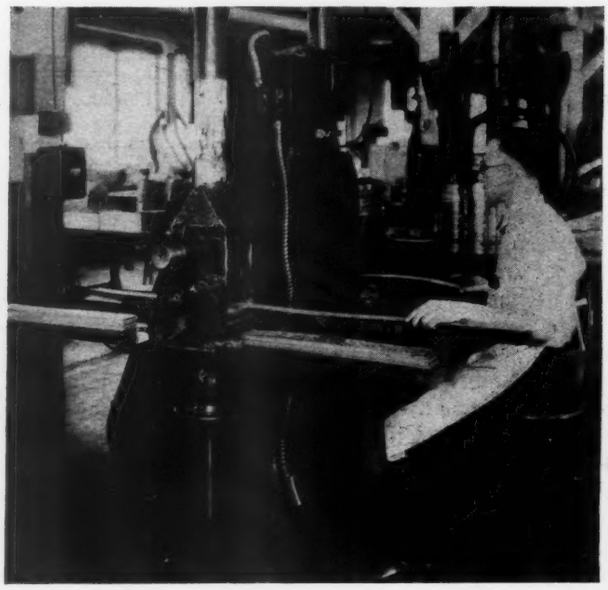

For Accurate Counting

SOURCE, General Electric Company, Schenectady, N. Y.

An automatic counting method that is readily adaptable to many other manufacturing operations is illustrated in the accompanying photograph, which shows a photoelectric magnetic counter used to register the number of mica strips fed into a milling machine. A beam of light focused on a photo-tube is intercepted as the strip leaves the machine, and the number shows on the counter mounted in front of the operator.

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Two Birds With One Stone

ARTHUR VAN VLISSINGEN, JR., Chicago

Winter shipment of products which are likely to be hurt by freezing is, of course, commonly done by refrigerator car. The problem of keeping the interior of the car above freezing temperature is, however, not too easy to cope with. Various expedients are in use, most of them rather expensive if satisfactory. But a plan used by Abbott Laboratories, North Chicago, Illinois, has the

virtue of a record of 100 per cent effectiveness to date, at a very low cost.

A pipe tunnel enters the shipping building just below the door leading to the carloading platform. Refrigerator cars are spotted here. It is necessary to ventilate the tunnel to remove excess heat. A large blower is therefore set above the tunnel, exhausting to the outside.

A large tube of waterproof canvas has been made into a duct which fits the vent of the blower. The end of this canvas duct is equipped with an elbow of sheet metal. When a car is spotted here, the elbow is stuck into the car through an icing hatch on the car roof.

The flow of warm air from the tunnel warms up the empty car, and continues to warm it and its contents throughout loading. When the car leaves, tightly sealed, it is at a good summer temperature. Shipments by the northern route to the Pacific Coast have gone through bitter cold weather all the way and reached destination with contents unharmed, without any subsequent attention.

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A Hartford, Conn., pieman believes in shouting out his wares—to the extent at least of identifying his handsome bakery by name and product, and floodlighting it the year round.

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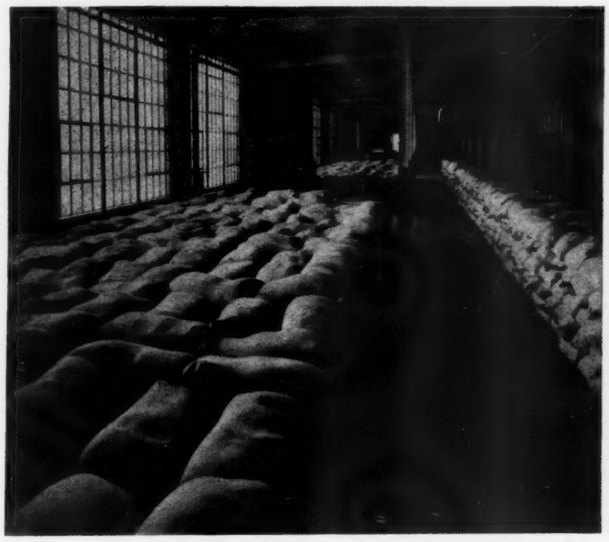


Putting Skids Under Storage Costs

SOURCE, William Freihofer Baking Company, Allentown, Pa.

Skid platforms do double duty in the flour storage room illustrated in the accompanying photograph.

First, they do away with the need for any intermediate manual handling; once piled on skids, the bags of flour stand ready for immediate removal to the baking process. Second, and hardly of lesser importance, the use of skids makes it possible to do a better job of circulating the clean warm air which has been found so necessary to the proper protection of this major baking ingredient.

Long-Lived Orifices For Process Lines

HARRY M. SPRING, Milford, N. J.

For many services small orifices are required in steam, water, or air lines. Where these lines are under about 1 in. in diameter and the required orifice size is less than one-half this diameter the plate-type orifice is rather unhandy, especially because of its comparatively short life. Where a high degree of accuracy is not necessary the following method of providing a permanent restriction of flow may be found useful in other plants.

After the orifice diameter has been determined a piece of cold-rolled, round-steel stock of the proper length for a pipe nipple is turned down to the outside diameter of the pipe line in which the orifice is to be placed. A hole of the required diameter is drilled through its longitudinal axis. Each end of this piece is threaded and it is fitted in the pipe line.

One of these "orifice-nipples" has been in service for more than six months, cutting down a stream of water at 300 deg. F. from 600 lb. per sq.in. pressure to 50 lb. pressure. Under these conditions a plate orifice would have only a short life.

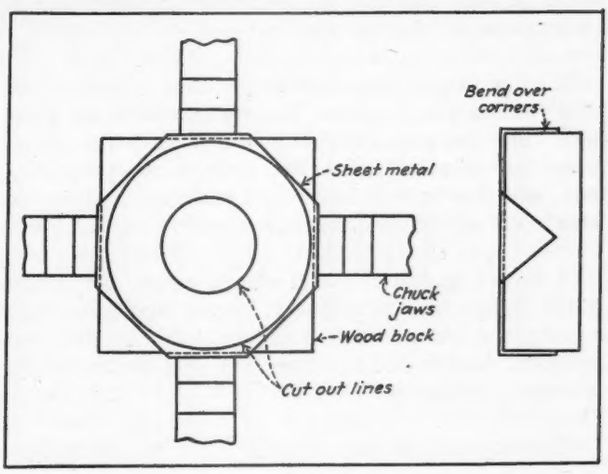
•

Cutting Washers in the Lathe

H. MOORE, Hamilton, Ont., Can.

I often have to make sheet-metal washers, with 6- to 12-in. holes—for example, felt-retaining washers for motor ends. I have tried all kinds of ways of holding them, bolting them to wood blocks held in the lathe chuck, bolting direct to the face plate, and gripping them in the jaw chuck itself. The danger is that thin sheet metal is likely to tear away from straps if the tool digs in as it cuts through.

Recently I tried out the method shown in the sketch and found it ideal. I cut a square block of hard wood, bent the corners of the sheet metal over the edges, and gripped the whole thing in the chuck as if it were one piece. Cutting a block of wood for one ring might seem, at first glance, a roundabout method, but since the job itself can be done so much more quickly and, what is most important, safely, it is worth the trouble.



· FACTORY FORUM ·

A new question is presented herewith, and readers' discussions of previous questions are published. Write down your opinions and send them to the editor. Answers published will be paid for

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How Big Is Maintenance *Now*?

Afternoon of a glorious autumn Saturday. George Shipman, works manager, and Frank Fulleger, plant engineer, associated with two plants in the same locality, are just plain loafing on Shipman's side porch. We listen in on the conversation as it leaves football for shop.

* * *

"I hate to feel low on a day like this, George. But all this NRA stuff has me wondering whether I've gone forward or backward in the last few months."

"Let's see if I get your drift, Frank. A couple of years ago you were master mechanic; then you were made plant engineer, which you are now. But during the two years of holding that office you've been given increasing responsibility, been taken into the confidence of the higher executives. Apparently they appreciate the things you've done. How can you feel that you might be going backward?"

Fulleger ponders the question—seems to be groping a bit—then speaks: "I mean in this way. We're doing pretty well at the plant, then along comes the Industrial Recovery Act. Up go costs, not only our labor costs, but the costs of materials and supplies. Immediately all the attention is given to our production problems. The big boss gets a new flair for motion study, and process charts, and redesign to cut out operations and add to sales appeal —and all that. And my old maintenance department is left to go on in its usual way."

Shipman laughs, and heartily at that. "Now I see what's eating you, I guess. You want to be in the limelight. For the past two years you've been the white-haired boy who could make the savings; the production boys, with few orders, low-priced materials, and bottom labor costs had to stand aside for you. That about it?"

"I hadn't analyzed it that way, George, but maybe you're right. At any rate, isn't it true that plant engineering and maintenance have lost some of their importance, their chance to make a showing because of the recovery proceedings?"

"Frank, you shock me. You don't talk like the brilliant young lad I've nursed along for so many years. I think you're of the track so far that we'd better quit talking. Let's go for a walk."

* * *

Obviously, readers of FACTORY MANAGEMENT AND MAINTENANCE can help Frank a lot. What direction would Shipman's lecture have taken, had he decided to loose it on Frank?

How Big Is Maintenance *Now?*

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ANSWERS TO PREVIOUS QUESTIONS

What of Cost-Cutting Equipment Under the NIRA?

(Question presented in the September issue)

THE QUESTION of policy concerning the increase of labor-saving and cost-cutting machinery in the face of NRA requirements is one which will burn more and more brightly as the Recovery Act gains ground.

Involved in the solution of this problem, I believe, lies the key to the economic upheaval in which we now find ourselves. Primarily, it must be recognized that, as a nation, the American people have become acutely conscious of economic issues. From office boy to chief, all minds are bent in the direction of economic discussion. Such problems as technological employment (or unemployment, if you will have it so) are national and involve every man, woman, and child. In this relationship, the doctrine of subjugation of individual desires to the needs of the mass is gaining creditable headway.

If new machines can be developed, which decrease the amount of human effort required, the goal thus attained is twofold.

In the first place, although perhaps the minor issue,

the aim of scientific research is served. The machine is put to work for men.

Secondly, while primarily aimed at a different goal, this result determines, in its own successful accomplishment, the success of the first. If the savings in dollars so made are utilized as tools wherewith to whittle down the selling price or ultimate cost to consumer, the results are newly developed markets in lower price—and the increased demand so developed will, of course, bring about increased production requirements, which offset the decrease in employment caused by gains in individual machine output.

The alternative of this latter is the absorption of such savings gained into surplus, with consequent maintenance of price, lack of expansion in market, and excessive profits. Now, of course, NRA will, according to its lights, require the turning back of such excess profits. However, how much more healthy it would be to turn them back before they become existent, through equitable price adjustment.

I am of the opinion, then, that if the machine is improved as fast as human ingenuity can improve it, if it is set to work to lower the burden of laborious effort, and to increase the ability of the people to purchase its products, it will be fulfilling the purpose of NRA. This may all be accomplished voluntarily and the results will then be quicker in coming. I have a strong suspicion, however, that this development is practically assured in any event.

As far as individual cases are concerned, the decision on this mighty important question must be made upon a basis of mass intent. The pitfall lies, as I have before stated, in the use or misuse of the cost differential.

Although perhaps a side issue, but I believe quite important to the grand total, is the subject of substitutes for productive effort. If the machine is going to be put to work, then men will be forced to don the harness for shorter intervals. A new problem is then raised. What is he going to do during the periods of inactivity? This is closely allied to the other problem, and is a subject which will have to bear the most careful thought and analysis. Of course, one can preach self-development and improvement of intellect, but it is another thing to sell this idea to the rest of us.

The reader may say that I have been too highly theoretical and that I have not answered the question specifically enough to meet the requirements of the individual. To this I say that the answer to each problem of individual, technological development lies in applying to it the rules of mass benefit.

P. W. SCHUBERT
Secretary to the General Manager
The New Departure Manufacturing Company
Bristol, Conn.

CERTAIN remarks of General Johnson, relative to the installation of new equipment in industries already having excess capacity, have been misconstrued as favoring a holiday on modernization, in spite of the fact that General Johnson himself has made it clear that the NIRA involves no curtailment of invention or initiative in mechanical progress. Many executives seem to think that the increase of efficiency in equipment and the transfer of labor from human beings to machines should be arrested. However, it is only necessary to carry this fallacious idea to absurdity, or back to the point where every individual performed everything himself, in order to show that it is impossible of acceptance.

Increasing the efficiency of machinery raises the standard of living. This follows because we can produce more of the goods and the comforts that make life easier and more convenient. The problem is not limitation of efficiency of production but one of distribution of the products of industry so that the standard of living can be raised. By making wages of labor high enough to purchase the products, this is accomplished. Wages cannot be raised indefinitely without a corresponding increase in production of labor. That increase is obtained largely through the use of more efficient machinery. It would be unfortunate if a brake were placed on the efficiency of industrial operations for fear we might produce too much.

We should concentrate our efforts on creating conditions such that our population may be able to consume the products of an efficient industry.

Unemployment cannot be remedied by inefficient operation. Those executives who were prepared to forego all improvements if their competitors would do likewise should have their false impressions corrected. Every effort should be made to make them understand that reasoning of this nature is obviously against public interest. It would add to unemployment in all capital goods industries and greatly increase the cost of production which would in turn raise prices to the point where purchasing power would be reduced. Shortening working hours, improving machinery, and installing labor-saving devices are the means of creating a higher standard of living. Why, then, should we have the spectacle of seeing manufacturers attempting to write into their codes limitations that to all purposes mean a moratorium on buying new cost-cutting equipment?

The short-sighted policy of prohibiting modernization to prevent outlay for equipment can lead only to a suicidal outcome. High-cost manufacture would ultimately reduce purchasing power. Increased unemployment in the capital goods industries would defeat the very purposes of the NIRA. It is certainly not the intention of the framers and administrators of the NIRA to limit our industrial progress and invention.

HARRY KAUFMAN, *Industrial Engineer*
Philadelphia

NOTWITHSTANDING the popular misconception that labor-saving machinery creates unemployment, there is a general agreement, among economists and those qualified to understand and interpret the various causes and effects operating in this department of life, that machines, on the contrary, create employment. This phenomenon, in its appearance and reality, is analogous to our solar system. Our eyes tell us that we are the center of the universe and that everything else turns about us, when the facts are diametrically opposite. If we are sick we go to the doctor, when in jail we call a lawyer. Why should we ask the man on the street whether machines are good or bad?

If we investigate any industry before and after the introduction of labor-saving devices we find that the number of men employed increased after mechanization. Temporarily, men are replaced, but in due course more

are absorbed. Machines reduce costs and place the commodity within the reach of more people.

One century ago a mob of French sailors burned the first steamship built in France, fearing that their jobs were jeopardized. But steam navigation has increased travel, by eliminating dangers and reducing costs, and today there are many times more men engaged in that industry than there were 100 years ago. Half a century ago, many people of this country went barefoot because shoes were a luxury few could afford. To protect their jobs, shoemakers opposed mechanization. But machines have lowered the price of shoes and made their use universal. As a result, tens of thousands more men are employed in that industry now than there were then. A quarter of a century ago, only the rich could afford a car, and relatively few men found employment making automobiles. By lowering costs, the machine has made it possible for practically everyone to buy a car, and employment in that industry has multiplied.

These are only high lights. But what has been said of these three industries is true of each and every one where machines have been made to do the work of men.

Why are there 15,000,000 men out of work in this country? No one has proved that machines are to blame. Why are there 400,000,000 out of work in China where there are no machines? If Americans would be content with cultivating half an acre of land and raising enough rice to live on, all of them would be employed after the Chinese fashion. The 15,000,000 unemployed Americans eat ten times better, dress ten times better, and live ten times better than the employed Chinese who cultivate their half acres of rice. The machine has made this difference.

There have always been depressions, from causes not yet discovered. These causes are economic and not technical, are as yet very vague, but their mysteries will soon be penetrated. In former times depressions were called famines, but they were the same thing. If people did not have corn or rice, they simply died by the millions. The machines have not done away with depressions, but they have certainly taken their sting.

Aside from these considerations, a manufacturer has no alternative but to install labor-saving machines when conditions demand. If he does not, his competitor will. If this country does not, other countries will. Today Russia is merchandising at a rate that should make every other country take notice. Wheat cultivation is planned on a scale that will reduce production costs to less than 10c. per bushel. Not to mechanize is to be left behind.

N. T. PEF, *Efficiency Engineer*
Crerar Clinch Coal Company, Chicago

What Are Employees' Obligations Under the NIRA?

(Question presented in the October issue)

DO THE employees under the NIRA have new obligations to their employers, obligations they did not have before? NO! No more so than the employers.

The National Recovery Administration did not find and discover new obligations for the employers of the country to assume. The purposes and plans of the NRA and the NIRA have merely called to mind obligations that actually existed in the days long before Adam Smith.

So the employers have assumed their obligations, tardily and inefficiently in many places, but they have been awakened to the realization that they are intimately concerned with the well-being of the Roes and Does on their payrolls.

So, too, the employees must assume their obligations. Those obligations existed before economists and theorists started writing. But not until now has there been any move to acknowledge and follow them.

Employees in general have been rather lax in assuming their share of the burden. This is perhaps to be expected when we think of the years when they were treated as machines. Still, it is to be regretted, for it is delaying the proper operation of the industrial machine.

Just what are these obligations? What is it that we want our employees to do? Very little, really.

The plea of the labor unions has always been a fair day's work for a fair day's pay. They have insisted on the fair day's pay, though sometimes we wonder if they have been quite as careful about the fair day's work.

Yes, the employees must turn in a fair day's work if things are to pick up once more. Employers, many if not most of them already hard hit, have lowered hours and raised wages. They have done their part. The employee must do his.

How? That fair day's work. Conscientious employees will try to reduce the quantity of errors; they will attempt to better the quality of the product by improving the efficiency of their work. Too long the employer-employee guerilla warfare has continued. It may not come until Utopia accompanies it, but sometime the world must realize that the employers and the employees are two red-blooded stallions who are hitched to a mighty wagon that can only be drawn by their sincere cooperation.

Cooperation of labor and capital will some day produce greater wonders than the world has yet seen. Antagonism between the two groups—well, the chaos of the past three years is a pretty fair sample of what it can produce!

It is too bad that no codes can be adopted which will bring the employees to a realization of their responsibilities in the same manner as those which woke up the employers of this nation. But the refusal of cooperation on the part of employees is more insidious and subtle than the refusals of the employer to cooperate with the NRA and the NIRA.

Employees ought to be more considerate of their employers; they ought to better their work so that the employer can sell his product and make up for his losses in wages; they ought to exercise more care in losses due to rejections and faults—and they ought to do these things, not because the NRA has provided them with new obligations, but because it has called them to mind. The light is there for all to see!

FRED BENNETT, *Superintendent*
Standard Products Company, Cleveland

QUESTIONS and ANSWERS

Conducted by G. A. VAN BRUNT

Trouble With Magnetic Switches

What conditions will cause magnetic switches to hum, flash excessively, and stick frequently? These troubles are apparent with several of our 440-volt switches, although the loads they are carrying are well within their rating. *J.A.D.—St. Louis, Mo.*

HUMMING of magnetic switches may be due to: (1) Loose iron in the magnetic circuit. (2) Face of polepiece or armature covered with dirt. This trouble usually shows up as a chatter rather than a hum. (3) Polepiece and armature out of adjustment so that they do not make complete contact when the switch is closed. A switch that opens on less than 40 per cent voltage drop usually has this trouble. (4) An operating coil designed for too high a voltage tends to cause chattering, weak closing force, or a tendency to open on small voltage drops. A coil designed for too low a voltage shows heating, too much closing force, and a heavy hum.

Excessive flashing may be caused by: (1) Arc chutes or magnetic blowouts being in poor condition. (2) Contacts that are rough or out of adjustment. When badly pitted, contacts should be replaced. Those that are slightly pitted should be smoothed with a fine file. All contacts should be adjusted so that they make and break at the same time. If one contact breaks before the others, the remaining two break single-phase load current. Check the contact springs—one may be weak. (3) Failure to keep fly lint and oily dirt out of the switch box. (Be sure to open the disconnecting switch before cleaning out the magnetic switch.) (4) Binding of the contact mechanism caused by dry or tight bearings, or rubbing of some moving part. (5) Slow opening, caused by binding, or the switch being mounted out of plumb.

Causes of sticking are: (1) Rough contacts welding together. (2) Dirt on the poleface contact pad. (3) Binding of parts.

Magnetic switches should be installed plumb and square, and the contact mechanism adjusted so that all contacts make and break together. Contacts on the average switch should make when the armature is about $\frac{1}{16}$ in. from the polepiece. Bearings should be lubricated with a light oil when installed and occasionally thereafter.

J. D. MCCONNELL
Greensboro, N. C.

ANY ONE of the following faults may be the cause of the trouble mentioned.

Rough contacts which do not close tightly or allow the magnetic circuit to be closed will cause humming. The remedy is to file the contacts smooth, with the switch out of service.

The voltage may not be normal, due to line drop at the switch or to poor contacts on the pushbuttons which operate the switches. Check the voltage across the holding coils. The pushbutton contacts should be clean and in good condition. They should be inspected whenever trouble is experienced.

The core of the magnetic circuit usually is made of iron laminations riveted together. These rivets may have

ANSWERS WANTED

Standard Costs for Maintenance Operations

Certain operations such as glazing and cleaning windows, painting, sweeping, scrubbing, and the like are performed periodically in all plants. Do you know whether "standard costs" or "standard times" have been worked out for such operations? If so what are they? *A.K.—Philadelphia, Pa.*

Laying Out Short-Center Drive

We will install an air compressor driven by a 200-hp., 580-r.p.m. motor through a short-center drive with idler pulley. The motor pulley is 28 in. in diameter, compressor pulley 84 in., and idler 19 in. All have 20-in. faces. I should like to know (1) What should be the distance between centers of the compressor and motor pulleys? (2) Is it necessary to have the centers of the motor and compressor pulleys on the same level? (3) Should the normal level of the idler pulley be above or below the level of the motor pulley? (4) What should be the center distance between the idler and motor pulleys?

R.C.—High Shoals, N. C.

What Instruments for Motor Testing?

We want to check up the efficiency and power factor of our motors, which range from 1 to 100 hp. They are three-phase, 60-cycle machines, operating at 220 volts. Since there is a large number of them, I should like to know the quickest and simplest way of making the tests. What instruments will be required? Also, please explain the difference between the "efficiency" of a motor and its power factor.

B.M.—Baltimore, Md.

become loose for any one of a number of reasons, and allow the plates to vibrate.

Flashing of the switch when the power is shut off may be due to its being overloaded, or connected to a highly inductive circuit. If trouble from this cause persists it may be advisable to replace the switch with one of larger capacity.

PUTNAM CILLEY
Buffalo, N. Y.

Penalizing Maintenance Department for Equipment Failures

We operate a metal-working plant and are considering charging against the maintenance department the cost of production delays caused by trouble with equipment for which it is responsible. These questions have come up: (1) Is such a plan inherently unfair? (2) Can it be applied successfully? (3) Are there any real advantages to it? (4) Do other plants have such a plan in force? (5) Should any allowances or exceptions be made in cases of equipment failure that can not be traced to neglect or improper care by the maintenance department?

H.E.W.—Detroit, Mich.

COST OF production delays caused by trouble with equipment should not be charged against the maintenance department, except possibly in the case of service equipment operated and supervised by this department. Under no circumstances should it be done when production machinery and equipment are operated and supervised by the production force.

The plan outlined probably would not be essentially fair because of the many complications that would arise. For example, who would decide in a satisfactory manner what should be classed as avoidable and unavoidable delays?

The thought back of the plan is sound; one having the same object, but based on a different principle, was put in force by the writer and yields results that are entirely satisfactory to all concerned.

An analysis to find to what extent certain maintenance problems lowered the theoretical production and increased maintenance costs led to an incentive for maintenance workers based on the production of departments in which they service the equipment, and on plant production for those who service equipment over the entire plant. It is obvious that maintenance expense is reduced and production increased by preventing breakdowns and the necessity for repairs. In other words, maintenance workers under the plan act in the capacity of machinery and equipment inspectors, noting and correcting irregular performance and cautioning operators against abuse of equipment.

It was not uncommon to find these men working on equipment during the lunch hour because they realized that any drop in production meant a reduction in their earnings. Such a plan reduces not only the cost of production delays, but the amount of labor and materials required for repairs and renewals.

It will not function properly, however, unless a wage-incentive plan based on time and motion study is in effect in the production departments.

H. B. BAUMBACH
Santa Monica, Calif.

IF A careful survey is made of all production equipment, recording the results in writing, and a special drive is made to put all machines in good condition, when breakdowns do occur and the production foremen send a written order to the maintenance department, requesting service, the latter department may be penalized for any neglect to render such service.

The simplest, most economical plan is to budget maintenance expense for each production department, allowing a definite, normal expenditure proportioned to the output. At the close of each pay period the actual expenditure for maintenance can be measured against the allowable expenditure to establish the efficiency of each department.

When this budget plan is combined with an incentive plan for production department foremen the efficiency in controlling maintenance expense becomes one of the factors in arriving at the bonus paid to the foremen, stimulating their interest to the point where "preventive" maintenance becomes something more than theory.

After all, the maintenance department is a service organization and its effectiveness can best be measured in terms of the efficiency of the production departments that it serves. When standards of maintenance expense have been established for each production department and actual expenditures are checked against these standards, the interests of the company are served and management has a direct measure of any neglect on the part of the various production department heads.

From my experience in many plants, large and small, I can see no advantages in a plan to penalize the maintenance department for equipment failures, when applied to a metal-working plant. In a process industry there may be some advantages. Many plants have in force the plan briefly outlined above, and operation has been successful in every instance.

C. F. SCRIBNER
C. F. Scribner & Associates
Asheville, N. C.

Checking Motor Loads by Kilowatt-Hour Meter

I want to check up the loads on some of our circuits and motors, but am hampered by the lack of instruments. It is possible, so I have been told, to do this by means of the kilowatt-hour meter on the switchboard. Will someone please tell me just how to do it?

T.M.K.—Nashville, Tenn.

DETERMINING the load on any motor or circuit with an integrating watt-hour meter is a simple matter. The results are accurate, although this method gives the average load over a period of a few seconds during which the speed of the meter disk is timed, rather than the instantaneous load value. Of course, only the motor on which a test is to be made should be in the circuit at the time the readings are taken.

A stop watch is required for short, accurate readings. It is also necessary to know the meter constant, which usually may be found on the disk, probably preceded by the letter *K*.

After the meter constant has been determined, connect the load to be tested, time the disk for a few revolu-

(Continued on advertising page 34)

Dual-Voltage Connections for Induction Motors

Three-phase delta series and parallel connections, twenty to twenty-four poles

A. C. Roe

Railway Engineering Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

THIS ARTICLE, the last of the series on dual-voltage connections for lap-wound induction motors, will cover the three-phase delta, 20-, 22-, and 24-pole connections, with directions for checking a new winding, and for retagging the nine leads of a winding when all or part of the lead tags are missing.

The method to be followed in connecting the motor leads to the line was given in Table IV, July, 1932, issue.

For twenty poles there are four possible dual-voltage connections: (1) Series and two-parallel delta, Figure 1; (2) two-parallel and four-parallel delta, Figure 2; (3) five-parallel and ten-parallel delta, Figure 3; (4) ten-parallel and twenty-parallel delta, Figure 4. These four dual-voltage connections can also be used to obtain six single-voltage connections, or a total of ten connections. [It is possible to reproduce with this article only three of the diagrams referred to. The others will appear in succeeding issues.—Ed.]

In the 22-pole range only two dual-voltage connections are possible: (1) Series and two-parallel delta, Figure 5; (2) eleven-parallel and 22-parallel delta, Figure 6. These two diagrams can be used to obtain four single-voltage connections, or a total of six different connections.

With 24 poles a total of fourteen different connections are possible—six dual-voltage, and eight single-voltage. The dual-voltage connections are: (1) Series and two-parallel delta, Figure 7; (2) two-parallel and four-parallel delta, Figure 8; (3) three-parallel and six-parallel delta, Figure 9; (4) four-parallel and eight-parallel delta, Figure 10; (5) six-parallel and twelve-parallel delta, Figure 11; (6) twelve-parallel and 24-parallel delta, Figure 12. These diagrams can be provided with equalizing connections by following the instructions given in preceding articles.

The article in the June issue, covering two-phase series and parallel connections for 18 to 24 poles included directions for checking the correctness of a dual-voltage winding connected according to the diagrams given in this series. The same directions can be used for checking delta connections.

Retagging Delta Dual-Voltage Windings

In the discussion of the 20- to 24-pole, two-phase and three-phase, star, dual-voltage diagrams, in the June and August issues, respectively, the procedure was outlined for identifying the leads of motors from which the tags have been lost. Although the delta connections are different in construction and require further discussion, the procedure is much the same as in the other connections.

With delta dual-voltage connections more care is necessary in determining the type of connections, since in the series and two-parallel connection there are two group leads attached to motor leads *L1, L2,* and *L3,* as shown in Figure 1, and with the two-parallel and four-parallel connection, Figure 2, there are four group leads attached to these leads. Hence, with delta connections there are three motor leads that can be identified as *L1, L2,* and *L3,* since there are twice as many group leads connected to each motor lead as there are parallels in the high-voltage connection.

From the foregoing it is evident that there is a rule for establishing the center point of each of the three groups into which a delta connection is divided, and each of these three groups has three leads attached to it. With a test light these three leads should be located and marked *A-A-A, B-B-B,* and *C-C-C,* respectively.

Next, select any one group and of the three leads locate the motor lead that has twice as many group leads attached to it as the other two motor leads, and mark this lead *L1.* From this lead select a group lead that picks up groups in a clockwise direction around the stator, mark the groups *1, 4, 7,* etc., and put on a direction arrow. Also, tag as *L4* the lead at the end of the series of groups. Next, take the other group lead, attached to motor lead *L1,* and trace through the groups, marking them *56, 53, 50,* etc., as in Figure 1, for example, and mark the finishing lead *L9,* as shown.

The first step, then, in retagging any type of delta, dual-voltage connection is to locate the *L1* lead and follow through the groups, marking them with numbers and arrows, and thus locate the *L4* and *L9* motor leads.

With one section of the winding marked, the next step is to select or draw a diagram, and finish marking the winding. Then start at group *31,* Figure 1, and check it for polarity and the position of motor lead *L7.* When this is done, six motor leads will have been identified and the seventh lead, *L5,* can be located with a test light.

Next, group *26* can be located on the winding and a check made for the polarity and position of lead *L6,* the eighth lead. The remaining or ninth lead, *L8,* can be located by using the test light and checking the number

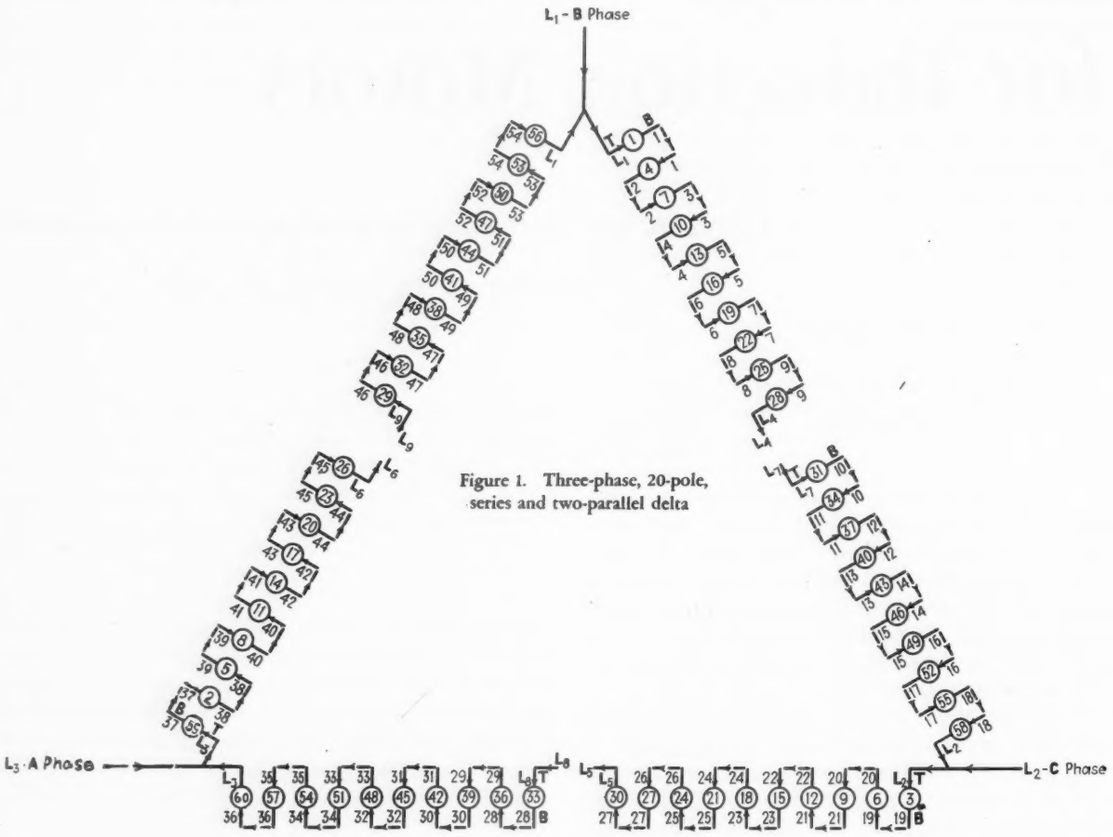


Figure 1. Three-phase, 20-pole, series and two-parallel delta

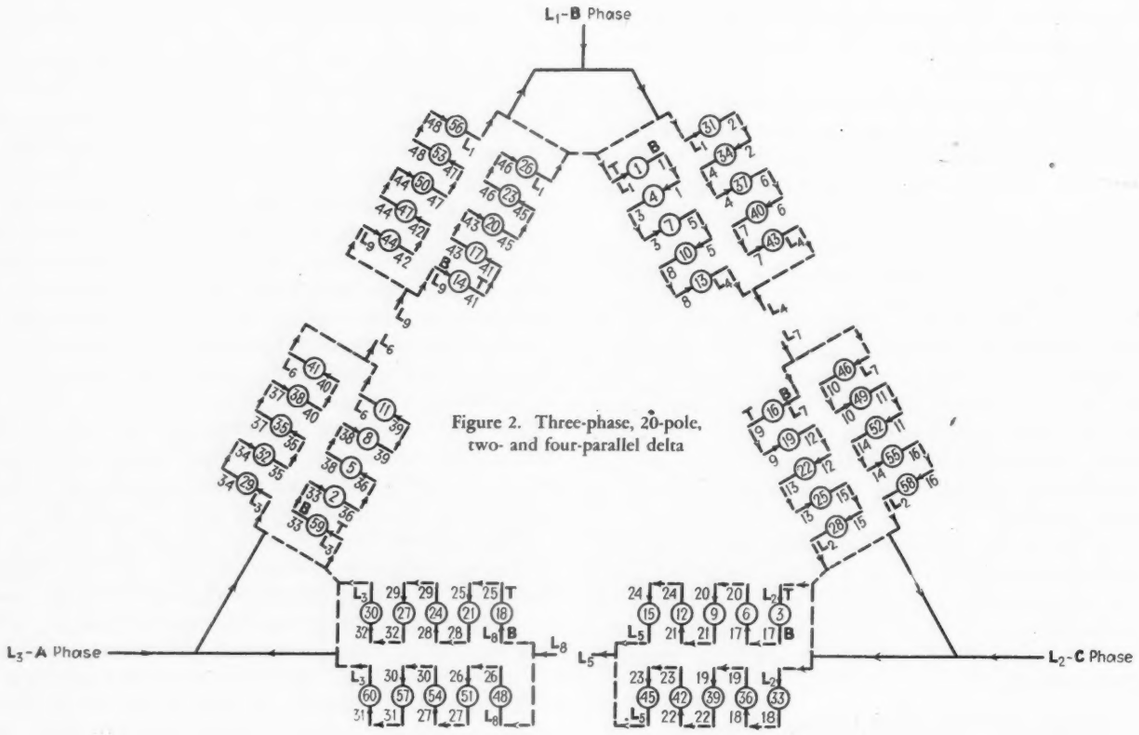


Figure 2. Three-phase, 20-pole, two- and four-parallel delta

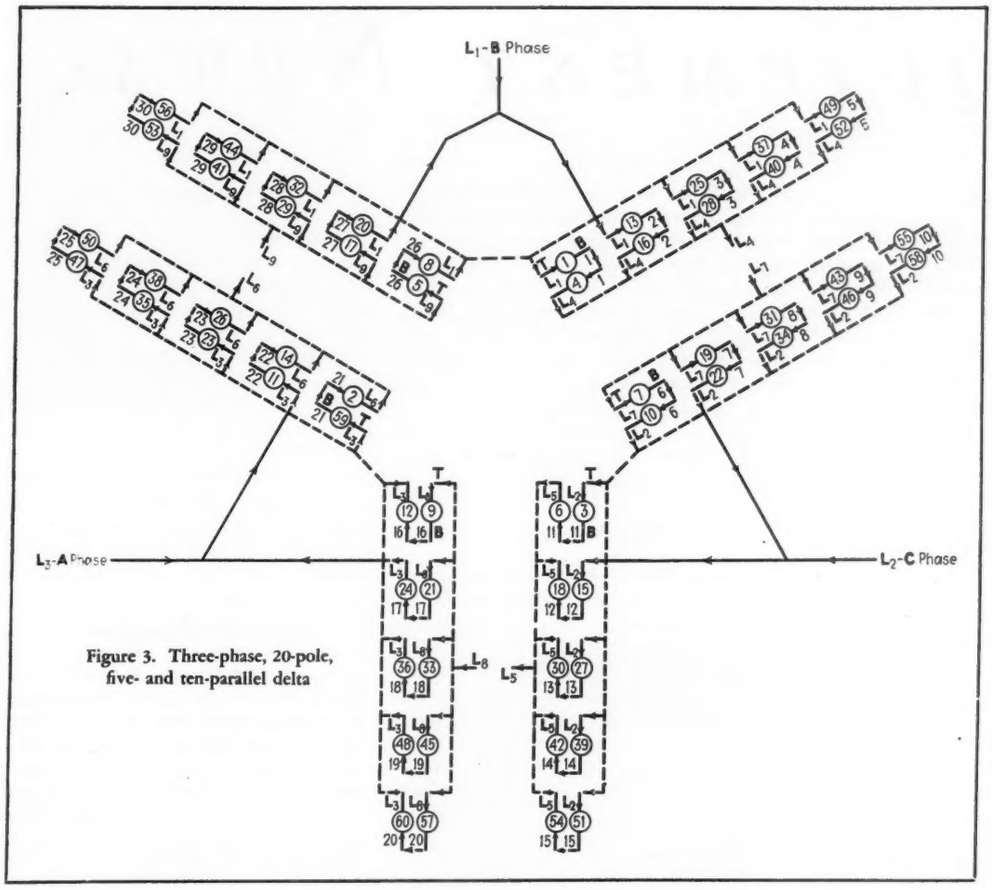


Figure 3. Three-phase, 20-pole, five- and ten-parallel delta

of group leads connected to it, to distinguish it from the *L3* lead.

It will be seen that the number of group leads attached to motor leads *L1, L2,* and *L3* provide a positive means of locating the center points of each section. When one of the other leads of a section has been located by the numbered groups on the winding, it is a simple matter in a series winding to locate the remaining motor lead.

Retagging Parallel-Connected, Dual-Voltage Windings

The preceding discussion has related to the series type of winding, which is comparatively simple. Now let us consider the six-parallel and twelve-parallel delta connection of Figure 11, as an example in re-marking the motor leads.

The first step is to divide the nine motor leads into three groups of three leads each, and mark the leads *A-A-A, B-B-B,* and *C-C-C*. Then take any one group, locate the middle lead as explained above and mark the lead *L1*. Next, locate each group to which an *L1* jumper connects, and mark each with a direction arrow, using the needle-pointed terminals of a test light circuit to insure the correct direction in passing through each group. A total of twelve groups will be marked.

Now start at any one of the marked groups and follow through it to the jumper, through the next group, and out onto the group lead connecting to the motor lead. Call this motor lead *L4,* and with the test light check for motor lead *L7* and tag it. Next, pass through all the groups in both parts of this first section, marking those that end on the *L4* lead as B groups, and those that end on the *L9* lead as A groups, using arrows at each group to mark the polarity. There will be twelve A groups and twelve B groups, which means that one-third of the total number of A-phase groups and a third of the B-phase groups have been marked.

The next step is to mark off on the winding the remainder of the B-phase groups. This can be done by starting at the last B group marked, calling it *1,* and counting over to *4,* or a pitch of 3. Then each group 1-and-4 apart, when starting the count on a B-phase group, belongs in the B phase.

After marking the last half of the B-phase groups start on any one B group and trace a connection out to a motor lead. By checking the number of group leads connected to the motor lead one can tell whether it is *L2* or *L7*; if there are 12 taps to the lead found, mark it *L2*. Then start on the same group and trace through it in the opposite direction and thus locate motor lead *L7*. With a test light find lead *L5* and tag it.

Locate leads *L6, L3,* and *L8* by following the same procedure. Therefore, by marking the groups in two phases, all nine of the motor leads coming out from the winding can be identified.

▼ ▼ ▼

·EQUIPMENT NEWS·

Screens

Style "B" Centrifugal, and "Aero-Vibe." For sizing either wet or dry materials. Style "B" built with one, two, or three decks in sizes from 2x6 ft. to 5x14 ft. Mechanically produced eccentric motion. Screen body floats on balance springs and entire screen is cable- and spring-suspended. "Aero-Vibe," also suspended from supporting structure by cables and springs, has adjustable vibrating motion produced by counterweighted wheels mounted on drive shaft attached to screen body. Single and double decks, available in sizes from 1½x3 ft. to 4x8 ft. For handling medium to fine materials in limited tonnage. Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

V-Belt Drive

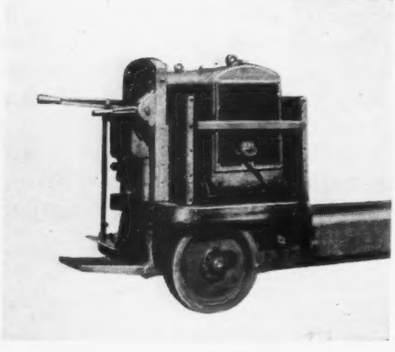
"Texrope." Available with one or both sheaves "Texsteel," and from ½ to 15 hp. Sheaves are grid-type construction with heavy-gage steel sections electrically welded at web and rim. Outer rims rolled for protection, appearance, strength. Integral bushings or solid bored hubs are standard. Aluminum finish. Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Temperature Controllers

For use in connection with heating applications. Include devices for indicating and controlling temperatures in tanks, machines, hydraulic press platens ovens and furnaces, melting pots, and other equipment. Thermostats for controlling temperature of electric units used for heating rooms, isolated shops, and offices. Edwin L. Wiegand Co., 7518 Thomas Boulevard, Pittsburgh, Pa.

Truck Power Units

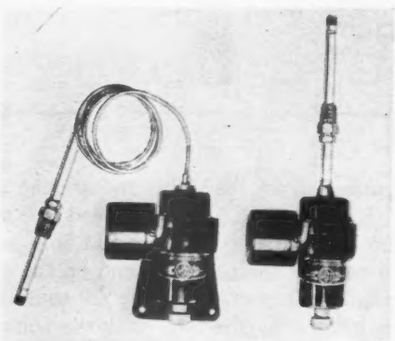
Gas-Electric, for replacing storage batteries in electric industrial trucks;



24, 30, 36, or 48 volts. Normal capacity rating, 3.6 kw. Maximum overload rating, 13.5 kw. Engine is 4-cylinder industrial type with 3½-in. bore, 4-in. stroke. Water-cooled, forced circulation by gear-driven centrifugal pump. Pump-driven pressure lubrication system. High-tension magneto, automotive-type carburetor. Five-gallon gas tank. Compound-wound, constant-potential d.c. generator. Dimensions, 40x22x28½ in. Net weight 840 lb. Syntron Co., Pittsburgh, Pa.

Thermostat

Bearing. For protecting motor-driven and other types of rotating machinery from breakdowns due to overheated bearings. For use in connection with automatic pumping stations, motor-driven fans, automatic electric substations, conveyor systems, refrigerating



machines, compressors. Consists of sealed metallic bulb, containing volatile liquid which is connected, directly or through flexible copper tubing, to one-piece seamless metal bellows. Electrical contacts are silver, double break. Rise in temperature of bearing of rotating machine causes volatile liquid to expand and generate pressure in bulb. Pressure is transmitted to bellows, causing contacts to open and shut down machine. The Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland.

Lamps

Three, neon glow, for low power consumption, long life, low brilliancy in general indicator service. G-10 is ½-watt, 110-120-volt, or 1-watt, 110-120-volt; S-14 is 2-watt, 110-120-volt. All have medium screw bases. One-half-watt lamp operates only on a.c., others on a.c. or d.c. Life expectancy 3,000 hr. at 105-125 volts. Red light. Westinghouse Lamp Co., Bloomfield, N. J.

Drive

"Unipower Agitator." Used for several years with Patterson machinery, now offered as separate agitator for all purposes. In both vertical and horizontal types. With 1,800-r.p.m. motors will produce shaft speeds down to less than one revolution per minute without use of gears. One- or two-way agitation. Especially adapted for installation over tanks or vats. Sizes from 40 hp. down to fractional sizes in several frame types. Requires no additional bearings or flexible couplings for installation. The Patterson Foundry & Machine Co., East Liverpool, Ohio.

Preheaters

The Superheater Company, New York, has acquired an interest in and assumed management of The Air Preheater Corporation, Wellsville, N. Y., manufacturers of Ljungstrom air preheaters. Air Preheater Corp. retains corporate identity under new management; will continue manufacture of its products at Wellsville.

Motors

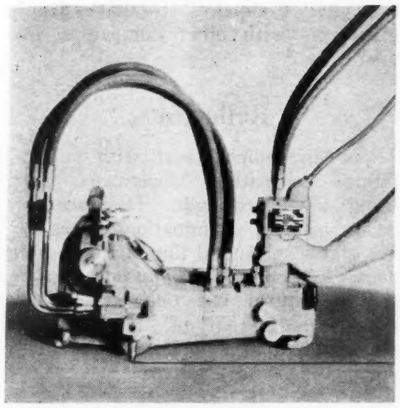
Dual. Sizes, ½, ¾, 1, and 1½ hp. Operate from d.c. generators on moving equipment when equipment is running, from central station power when equipment is standing. For operating portable tools from either direct or alternating current. Consists of two motors in one two-bearing frame with two rotors on one shaft. Requires only one shaft connection to driven apparatus. Century Electric Co., St. Louis, Mo.

Call System

Semi-portable, for factory use. Called "Amplicall." Six standard models. No interference with regular switchboard or signal systems. Entire system can be installed by ordinary mechanic. Consists of Type K Webster portable amplifier for master station, carbon-button-type push-button microphone, and 1 to 5 speakers located at strategic points on premises. Webster Co., Chicago.

Wheel

Textolite, truck. Plain or Hyatt bearings. Sizes from 3¼ to 12 in. in diameter, 1½- to 2½-in. face, 2⅞- to 3½-in. hub. Tap-seated Alemite or Zerk fittings standard for larger sizes. The Service Caster & Truck Co., Albion, Mich.



Cutting Machine

Portable. Known as "Secator." Consists of Oxweld Type C-14-H blowpipe mounted on electrically driven, air-cooled, dust-proof chassis. Direct drive, universal motor, 110 or 220 volts. Runs either on 1½-in. angle-iron track, furnished, or on smooth plate. Operated on track, it does straight-line cutting automatically. Hand-grip for cutting simple shapes. Center and radius rod for cutting circles automatically. Oxygen and acetylene valves on chassis. Blowpipe adjustable for vertical, horizontal, or bevel cutting. The Linde Air Products Co., 30 E. 42nd St., New York.

Outlet

Weatherproof, for outdoor lighting fixtures and appliances. Brass, cadmium-coated. Flush plate has solid rubber pad on back for snug fit when in place. Cap slips over cord plug and screws onto device. Another rubber-insulated cap, chained to outlet, screws over it when not in use. General Electric Co., Schenectady, N. Y.

Grinder

Portable, electric. Called "Hand-ee Hi-Power." Three grinding wheels furnished, over 100 shapes and sizes of wheels available. Maximum speed 17,000 r.p.m. Works on 110 volts a.c. or d.c. Dust-sealed ball bearings. Weight 3 lb. Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago.

Rules

"Push-Pull." Flexible. Six-foot. Nickel-plated blades can be removed from 2-in. cases for end-to-end measurements. No. 3506 has octagonal case, blade graduated on lower edge only; No. 3306 round steel case with gun-black finish, blade graduated on both edges; No. 3206 round brass and steel case, chromium plated, blade graduated on both sides, all four edges. Stanley Tools, New Britain, Conn.

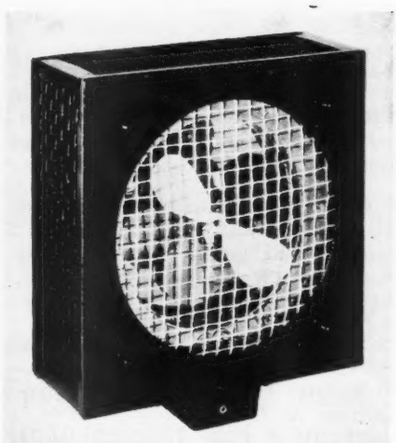
Coupling

Light-duty "Fast's." Self-aligning. Sizes 1 to 2⅛ in., 2 to 15 hp. per 100 r.p.m., maximum speed 3,600 revolutions. Forged steel hubs, die-cast zinc-base sleeves. The Bartlett Hayward Co., Baltimore, Md.

Lamp

Two-filament, three-light. Two sizes, one containing 150- and 200-watt filaments, other 200- and 300-watt filaments. Bulb sizes same as regular Mazda 300- and 500-watt lamps. Inside frosted. Screw bases have additional center contact permitting separate control of filaments. Life in service, 1,000 hours. General Electric Co., Nela Park, Cleveland.

Unit Heaters



Electric, blower-type, "Heetflo" principle. Called "Chromalox." Portable. For operation on 115 or 230 volts, 60 cycles a.c. D.C. heaters available. Six models in ratings from 1.5 to 4.5 kw. Automatic temperature control also available. For auxiliary, temporary, or permanent installation. Edwin L. Wiegand Co., 7518 Thomas Blvd., Pittsburgh, Pa.

Wedge Socket

"No Pinch," for wire rope. Sizes from ⅜ to 2⅜ in. Made from steel casting. Pins turned and bearing surfaces machined. John A. Roebling's Sons Co., Trenton, N. J.

Thermometer Controller

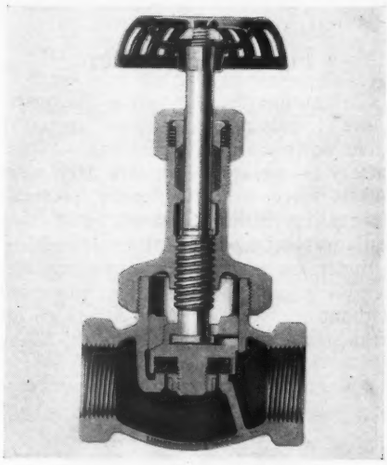
Automatic, with mercury switch. Motor-driven control table determines location of pen on chart every six seconds, tilting mercury switch if temperature has changed. Measuring mechanism free to position itself. Mercury switch, sealed in glass, mechanically locked in place until automatically reset. Capacities up to 15 amp. at 110 volts, 10 amp. at 220 volts. Adaptable to one-, two-, and three-contact control or signalling systems. In two-record controller, each control mechanism can control separate device. Also supplied as time-temperature cycle controller. Adaptable for control of pressure, liquid level, and other factors. The Brown Instrument Co., Philadelphia, Pa.

Wrench and Vise

"Velvo-Grip." Claimed by manufacturer to hold any material without scratching, crushing, or otherwise injuring it. Full-length wood jaws grip material. Jaws in vise and wrench interchangeable. Lock in position when pressure is applied, release when tapped. Vise consists of two-part malleable iron frame, set of cushion jaws, and screw yoke. Lower part of frame forms base. Wrench also has two-part frame, but depends on cam action for grip. Wolverine Industries, Harbert, Mich.

Valve

Non-metallic-disk, bronze. Suitable for 150-lb. steam, 300-lb. gas-liquid pressure. Repackable under pressure. Three basic disks for steam, hot water, cold water, air. Other disks available. Globe, angle, horizontal- and angle-



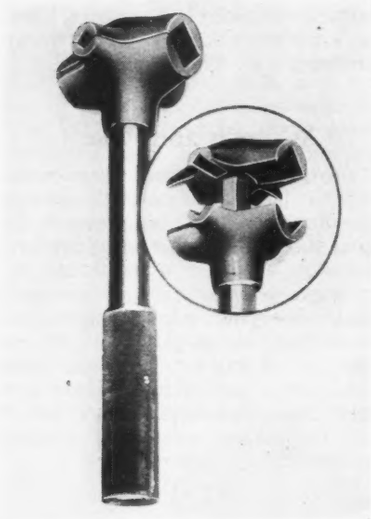
check, spring-check, and quick-operating designs. The Lunkenheimer Co., Cincinnati.

Switch

Automatic, solenoid-operated, across-the-line. Rated at 5 hp., 220 volts, 7½ hp., 440-550 volts for polyphase motors, and up to 1½ hp., 110 volts, 3 hp., 220 volts for single-phase self-starting motors. In three forms: with start-and-stop push buttons; without push buttons for thermostat or remote pilot control; with two-way hand-automatic switch for

try-out control installations. Double-break silver-alloy contacts. Overload protection. Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis.

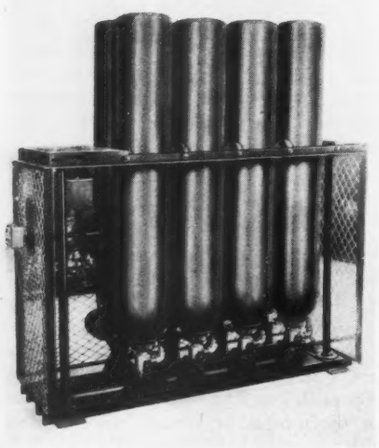
Wrench



Balcrank "Fits-All" Super. For all square and hex nuts from $\frac{5}{16}$ to $2\frac{1}{2}$ in. Special plugs for insert nuts. Hammer attachment. Head drop-forged S.A.E. 1035 steel. Shaft manganese steel, case hardened. Cincinnati Ball Crank Co., Cincinnati.

Fire Extinguisher

Carbon-dioxide. Known as "Inverted Alfite" system. Cylinders mounted valve downward on trunnions. When battery is operated, cylinders drop with 160-lb. force on cutter knobs, piercing gas-sealing disks, releasing gas. Installation and replacement require setting cylinder on trunnion and making one flexible connection. Can be inspected without discharge of gas. American La France & Foamite Corp., Elmira, N. Y.



Melting Pot

Electric. Called "Junior." For melting and keeping in molten condition all metals or materials with melting point as high as those of tin and solder. 110 volts, 275 watts. Pot capacity 4 lb. Height $4\frac{1}{4}$ in., width $6\frac{3}{4}$ in. Can be furnished for 220 volts. The Newton Junior Corp., 151 Court St., New Haven, Conn.

Building Material

Masonite Corporation will manufacture hard boards and hard board products for distribution under trade name of Celotex Company. Similar agency agreements with other companies are under way.

Reflector

Porcelain-enamel, bowl, with concentrating prismatic "Controlens" for strong downward light. Designed for use in medical examination offices, to give glareless general illumination at all times. For clinical examination, turn of pendant control rod uncovers "Controlens" in bottom of unit, sending strong light to examination area. The Holophane Co., 342 Madison Ave., New York.

TRADE LITERATURE

CIRCUIT BREAKERS—Folder, "Low Cost Circuit Protection with Nofuze Industrial Circuit Breakers."—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COMPRESSORS — Bulletin L-600-B3, information on vertical duplex type; Bulletin L-622-S1, Complete specifications on vertical duplex type.—Worthington Pump and Machinery Corp., Harrison, N. J.

COMPRESSORS — Bulletin L-600-B2, 16 pages, "Worthington Compressors Equipped with Feather Valves for Refrigeration."—Worthington Pump and Machinery Corp., Harrison, N. J.

ENGINE — Bulletin S-550-S5, vertical four-cycle gas engine, 180 to 360 hp.—Worthington Pump and Machinery Corp., Harrison, N. J.

FLOOR—Catalog C, A.I.A. File No. 3-d-5, "Alundum Aggregate." — Norton Co., Worcester, Mass.

FLOOR—Folder, "Inland 4-Way Floor Plate."—Inland Steel Co., First National Bank Building, Chicago.

FUSE—Booklet, "Fuse Check Book."—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GAGE—Folder, "In 1930 a Revolution was Started by All-Steel Spring Recording Gauges."—The Foxboro Co., Foxboro, Mass.

GAS-ELECTRIC SETS — Circular, "Gas-Electric Sets for Every Application."—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GRINDERS—Folder. "Grind More, Speed Up Production, Cut Costs With Hand-ee Hi-Power Portable Grinders." — Chicago Wheel & Mfg. Co., 1103 W. Monroe St., Chicago.

HEATER—Bulletin of list prices covering "Convectofin Built-in Heaters." — Commodore Heaters Corp., 11 W. 42d St., New York.

HEATERS — Catalog pages, "Automatic Electric Water Heaters for Industrial Use, Model W-45." — General Electric Co., Schenectady, N. Y.

INSTRUMENTS — Folder, "Hundreds of Dollars Saved by Analyzing Chart Records."—The Brown Instrument Co., Philadelphia, Pa.

INSTRUMENTS — Bulletin GEA-1784, "New Portable Instruments." — General Electric Co., Schenectady, N. Y.

IRON, STEEL, WIRE—Circular, "Tables of Values of Iron, Steel, Wire and Metal Materials."—Oliver Brothers, Inc., 200 Hudson St., New York.

MELTING POT — Pamphlet, "Here is 'Junior,' the Electric Solder and Melting Pot You've Been Looking For." — The Newton Junior Corp., 151 Court St., New Haven, Conn.

PLASTICS—Price List and Data Booklet GEA-937C, "Plastic Products Price List." —General Electric Co., Schenectady, N. Y.

PRODUCT DESIGN — "Case Histories in Product Design," reprinted from PRODUCT ENGINEERING.—Market Development Division, The New Jersey Zinc Sales Co., 160 Front St., New York.

PUMPS — Bulletin D-316-S1, Vertical Freflo centrifugal type for sewerage, sump, and drainage service; Bulletin W-317-S1A, Horizontal Freflo centrifugal type for handling sewage and other liquids containing solid matter in suspension.—Worthington Pump and Machinery Corp., Harrison, N. J.

RELAYS—Bulletin, GEA-1654A, "CR7505 Photoelectric Relays."—General Electric Co., Schenectady, N. Y.

STEEL—Folder, "Ingoclad, Mild Carbon Steel Clad with Stainless."—Ingersoll Steel & Disc Co., 310 S. Michigan Ave., Chicago.

TEMPERATURE CONTROLS—Bulletin TA-120, "Temperature Controls for Use With

(Continued on advertising page 36)